FEBRUARY, 1934.

GENERAL PHYSICS.

ADSORPTION.

396. Possible Magnitude of the Sorption Error in Measurements Involving Easily Sorbable Gases at Low Pressures. M. Francis. *J. Phys. Chem.* 37. *pp.* 1019–1027, *Nov.*, 1933.—Errors in the interpretation of experimental results involving measurements of pressure changes in apparatus containing easily sorbable gases at pressures below 0·1 mm. of mercury are indicated by comparison of a typical sorption isotherm and the isochor of an apparatus of two litres capacity, which shows that the gas sorbed may approach or exceed in amount that contained in the free space, and may entirely escape detection; but in the case of glass as sorbent a part of the pressure-sensitive sorbed gas may be observed from the time-lag in attainment of equilibrium. Results for sulphur dioxide are illustrated by plotting variation of apparent free gas against time. A temporary disengagement of sorbed gas amounting to more than 50 % of the free gas was observed. N. M. B.

397. Heats of Adsorption of Noble Gases and Carbon Dioxide at Ion Crystals. F. V. Lenel. *Zeits. f. phys. Chem.* 23. *Abt. B.* 5–6. *pp.* 379–398, *Dec.*, 1933.—The energies of the molecular attraction involved in the adsorption of noble gases and carbon dioxide at ion crystals is calculated theoretically. This energy is due to London's dispersion force, an influence force and, with polar gases, of a dipole and a quadripole attraction. With the aid of a heated wire manometer, the adsorption isotherms of A, Kr, and CO_2 on finely powdered KCl and KI, LiF, CsCl, and CaF_2 have been determined at low pressures, and the heats of adsorption are calculated from the change of the adsorption isotherms with the temperature. Satisfactory agreement is shown between the calculated and experimental results. The high value found for the adsorption potential of A on CsCl is confirmed by the theoretical calculation and is explained by the fact that the adsorption occurs at the crystal faces 100, which are occupied by only one ion type, whereas in the NaCl lattice the cube faces contain anions and kations in equal numbers. T. H. P.

398. Adsorption of Neon on Glass at Liquid Hydrogen Temperatures. W. H. Keesom and G. Schmidt. *K. Onnes Lab., Leiden, Comm. No.* 226*a*. *K. Akad. Amsterdam, Proc.* 36. 9. *pp.* 825–831, 1933.—Measurements have been made on the adsorption of neon on glass at four temperatures in the liquid hydrogen range. It appears that in increasing the pressure the covering of the wall proceeds regularly and that complete covering with a monomolecular layer is reached at about the saturated vapour pressure. The adsorption isotherms are represented fairly well by the formula: $q^3 = p/(0\cdot7(p_s - p) + p)$, q being the fraction of the wall covered, p the pressure, p_s the saturated vapour pressure. AUTHORS.

399. Adsorption of Helium on Glass at Liquid Helium Temperatures. W. H. Keesom and G. Schmidt. *K. Onnes Lab., Leiden, Comm. No.* 226*b*. *K. Akad. Amsterdam, Proc.* 36. 9. *pp.* 832–841, 1933.—The adsorption of helium on glass was investigated at liquid helium temperatures. The results can be represented fairly well by the formula $p/(0{\cdot}26\ (p_s - p) + p)$. One measurement on the adsorption of hydrogen at 15·1° K. was made. It was tried to make helium thermometer measurements below 1° K. possible by adding some neon. This procedure did not lead to success. AUTHORS.

400. Adsorption of Hydrogen Atoms by Iodine and Calcium Fluoride. J. H. de Boer and J. J. Lehr. *Zeits. f. phys. Chem.* 24. *Abt.B.* 1. *pp.* 98–102, *Jan.*, 1934.—Comparative measurements were made of the adsorption of H atoms and I_2 molecules by CaF_2 which had been sublimed *in vacuo*. The measurements were carried out in a suitably modified lamp. The results showed that, under favourable conditions, twice as many H atoms as I_2 molecules were adsorbed. With large quantities of the salt, the adsorption of H atoms was reduced as it was unable to penetrate through the surface of the salt crystals. F. J. B.

401. Spectrographic Measurements of Adsorption with Solutions of Metallic Ions at the Surface of Powders. E. Berl and B. Schmitt. *Kolloid Zeits.* 65. *pp.* 264–267, *Dec.*, 1933.—The method used is that of the " last lines," that is, those few lines of the emission spectra which appear when a highly dilute solution of a metallic salt is evaporated in the luminous arc. By this method it is found possible to follow, rapidly and with the use of minimum quantities of material, the adsorption of metal ions at the surfaces of powders, as in the flotation process. As little as 0·001 % of a metal ion, *i.e.*, 10 mg. of metal per l. of solution, is detectable in this way. Quantitative study of the adsorption has been attempted by applying Scheibe's logarithmic sector to the measurement of the relative intensities of the last lines, but certain difficulties were encountered. T. H. P.

402. Relation of Water Held by Charcoal at Zero Pressure to the Ash Content. L. J. Burrage. *J. Phys. Chem.* 37. *pp.* 1095–1101, *Dec.*, 1933.—A number of ash determinations have been carried out on different charcoals; and a comparison made with the amounts of water held at zero pressure. An examination of other available data has been made. A theory has been advanced to account for this variation in the quantity of tightly held water, in which it has been suggested that the ash plays no part in the retention of the water at zero pressure, but that the latter is held in a quasi-chemical manner by the active centres and C_xO_y complex. AUTHOR.

See also Abstracts 497, 502.

ATOMIC AND MOLECULAR STRUCTURE.

403. Heisenberg's Nuclear Theory. H. Mandel. *Phys. Zeits. d. Sowjetunion*, 4. 4. *pp.* 640–650, 1933.—The difficulties associated with Heisenberg's nuclear theory are discussed and a hypothesis which is claimed to remove them is proposed. It is suggested that the charge carried by particles can be to a certain extent quantised and the hypothesis is embodied in the following formula: proton charge $= (1 + \rho)\epsilon/2$, and electron charge $= -(1 - \rho)\epsilon/2$, where ρ is an operator which can have either of two values + 1 and − 1. A neutron thus corresponds to $p = 1$. Zero charge electrons, corresponding to $\rho = +1$ are proposed as components of the nucleus. The advantages of this hypothesis are described in detail. J. E. R. C.

404. Constitution of Heavy Nuclei. A. Schidlof. *Helv. Phys. Acta*, 6. 8. *pp.* 581–596, 1933. *In French.*—The possibility is discussed that besides ordinary α-particles (of two protons and two neutrons, p_2n_2) there may exist in heavy nuclei ($Z > 17$, atomic weight $> 2Z$) particles, α_1, consisting of one proton and three neutrons, p_1n_3. If M_α, M_{α_1}, M_p, M_n are the masses of α, α_1, p and n respectively $M_\alpha = 2M_p + 2M_n - 0{\cdot}037$, and $M_{\alpha_1} - M_\alpha = 0{\cdot}029$, so that α_1 tends to transform into α with possible emission of a β-particle. The nucleus would thus consist of α_1 particles (with smaller electric charge) in the centre surrounded by a layer mainly of α particles (there may be some pn or pn_2) through which barrier there is a small but definite probability of an α_1-particle passing, and of transforming into an α-particle with emission of a β-particle, thus accounting for radioactivity [see Abstracts **3319** (1932) and **1842** (1933)].
C. A. S.

405. Electrical Theories of Matter. A. Lartigue. *Soc. Franç. Élect., Bull.* 3. *pp.* 1113–1144, *Nov.*, 1933.—Chapter I contains a short account of the history of atomic theory. In the view of the author the planetary (" Saturnian ") model of the atom has been studied from a point of view too markedly electrostatic. He therefore suggests a series of models resembling the various types of winding that are used in electrotechnical practice. Chapter II discusses modern theories of mass, particularly in reference to its dimensions. In his view mass is characterised by a length in motion just as energy is characterised by a mass in motion—consequently force is expressible as the fourth power of a velocity, being the product of two distinct velocities, one of which is the " vertical " atomic velocity and the other the velocity of the mass as a whole. Chapter III gives an account of how models may be set up for matter in the three aggregate states. Assuming that the mass and the charge of a satellite electron may be distributed over the whole length of its orbit, which thus becomes a ring (equivalent to a magnetic " shell "), the author deduces a toroidal structure for the gaseous state, an ellipsoidal structure for the liquid state and a foliated structure for the solid state. The relation of these models to crystalline structure is illustrated by copious diagrams and tables.
H. L. B.

406. Artificial Disintegration of Boron. F. Heidenreich. *Zeits. f. Physik*, 86. 9–10. *pp.* 675–693, *Nov.* 28, 1933.—A description is given of a reinvestigation of the protons emitted from boron when it is bombarded with α-particles from polonium. The particles were detected using the Hoffmann and Pose method and their range distribution determined for various ranges of the incident α-particles. Attention was paid to determining the best geometrical conditions and it appears that while the 30 cm. and 76 cm. groups are apparently homogeneous, the small range group always appears to be inhomogeneous. It is deduced that this latter corresponds to a disintegration without capture of the α-particle. The other two groups are ascribed to the results of the capture of an α-particle, the shorter being accompanied by γ-radiation. Fair agreement is obtained between the energy of the γ-radiation predicted on this assumption and that observed by Bothe. The energy emissions corresponding to the 14 cm., 30 cm. and 76 cm. ranges are given as $-1{\cdot}9$, $+1{\cdot}27$ and $+7{\cdot}63 \times 10^6$ e.v. respectively.
J. E. R. C.

407. Range Distribution of the Disintegration Products of Boron on Bombardment with Protons. F. Kirchner and H. Neuert. *Phys. Zeits.* 34. *pp.* 897–898, *Dec.* 15, 1933.—Continuing previous work [see Abstract 3476 (1933)] the range distribution of the disintegration products of boron on bombardment with protons is determined from the examination of 2500 tracks obtained by the cloud method. The α-rays from a strong polonium source were used for calibration. A large number of tracks of low range is found, but the number falls off rapidly as the range is increased. It rises again, however, to a sharp maximum at about 31 mm. and then falls off rapidly to a very small number at about 40 mm. This is followed by another well-defined maximum at 45 mm. and the distribution then falls again to end sharply at 48 mm. F. C. C.

408. Separation of Hydrogen Isotopes by Diffusion through Palladium. L. Harris, W. Jost and R. W. B. Pearse. *Nat. Acad. Sci., Proc.* 19. *pp.* 991–994, *Dec.*, 1933.—The theory of separation by diffusion is examined. Atomic rather than molecular separation should be more efficient owing to the higher mass ratio. Experimentally, by pumping off the lighter isotope on the low pressure side, it was found that a ten-fold enrichment in the heavier isotope could be obtained. The concentration was found by spectroscopic examination. The diffusion appears to be an atomic process involving an activation factor favouring diffusion of the lighter isotope. N. M. B.

409. Separation and Properties of Hydrogen Isotopes. H. C. Urey. *Science*, 78. *pp.* 566–571, *Dec.* 22, 1933.—A lecture outlining methods of separation, and a short survey of the thermodynamic, physical, kinetic and physiological properties of the hydrogen isotopes and their compounds. N. M. B.

410. Quantitative Relations of the Lithium Isotopes Li^7 and Li^6. L. S. Ornstein, J. A. Vreeswijk, Jr. and G. Wolfsohn. *Physica*, 1. *pp.* 53–59, *Dec.*, 1933. *In German.*—Measurements were made of the intensity of the Li resonance line $\lambda = 6708$ Å and the results obtained were tabulated. These lead to a quantitative relation of the Li isotopes Li^7 and Li^6 of $8 \cdot 1 \pm 0 \cdot 4$. This gives good agreement with the value $7 \cdot 2$, obtained by Wijk and Koeveringe from measurements of the band spectrum. The differences from values obtained by other experimenters when using different methods are not yet explained. R. S. R.

411. Symmetric States of Atomic Configurations. F. Seitz and A. Sherman. *J. Chem. Phys.* 2. *pp.* 11–19, *Jan.*, 1934.—In the secular equations used by Eyring and his school the equations are of high order in general. When cognisance is taken of the symmetry of the configuration considered the secular equation may factor considerably. It is to be expected that the wave function for the lowest state will be invariant under the group which expresses the symmetry of the atomic configuration. This expectation is fulfilled in all cases considered. A general method is set forth upon which a derivation of such symmetric states may be carried out, and the reduced secular equation obtained. Several interesting applications of this method are carried through, including the case of eight identical orbits, centred at the corners of a cube, and eight orbits possessing tetrahedral symmetry, as in methane. The vector model is discussed and applied to the cases considered. AUTHORS.

412. Energy Content, Particle Dimensions, and Lattice Formation of Active Beryllium Oxide. R. Fricke and J. Lüke. *Zeits. f. phys. Chem.* 23. *Abt. B.* 5–6. *pp.* 319–329, *Dec.* 1933.—It is found that the beryllium oxide (BeO) prepared at different temperatures from metastable crystallised beryllium hydroxide has a higher energy content the lower the temperature at which it is obtained; the energy differences amount to over 1 k.cal. per mol. X-ray investigation of specimens of different preparations gave colloidal dimensions for the hexagonal crystallites which were smaller the larger the energy content, and amounted to 22 – 10 mμ in the direction of the a – axis and 6 – 2 mμ in the direction of the c – axis. It was ascertained from the intensities of the interferences that lattice formation was incomplete in the preparations of greater energy content. H. H. Ho.

413. Electronic Interference Experiments with Active Beryllium Oxides. R. Fricke and J. Lüke. *Zeits. f. phys. Chem.* 23. *Abt. B.* 5–6. *pp.* 330–337, *Dec.*, 1933.—The photometric evaluation of the kathode-ray interference photographs of active beryllium oxides shows that the intensities of the interferences with rising preparation temperatures of the specimen first rise and then decline again, the increase being especially strong for the higher interference orders. This result indicates that the specimens prepared at lower temperatures possess poor lattice formation, while the highly heated oxides have large particles. H. H. Ho.

414. Electronic Structure of Inorganic Complexes. W. A. Noyes. *Am. Chem. Soc., J.* 55. *pp.* 4889–4893, *Dec.*, 1933.—On the basis of Sidgwick's assumption that the " co-ordinated " ions and molecules of the Werner complexes are " donors " and the central metallic ions are " acceptors," combined with the principle that a donor increases its positive ionic valence by one and that an acceptor increases its negative ionic valence by one, a simple explanation of the ionic charges of the complexes is given. The importance of the distinction between the " potentially polar " covalences and ionic valencies is discussed. The possibility of the rearrangement of the negative nitrite and cyanide ions to positive nitro and isocyanide groups is explained. H. H. Ho.

415. Structure of CH_4 and Related Molecules. Part III. J. H. van Vleck. *J. Chem. Phys.* 2. *pp.* 20–30, *Jan.*, 1934.—Use of Johnson's formulas for sp^3 levels in conjunction with existing experimental data makes it doubtful whether the ^5S state of the carbon atom is only 1·6 volts above the ground state, as often assumed in the literature. A formula is derived for the energy of the " valence state " of the C atom, which is a linear combination of sp^3 levels wherein the spins are paired with those of attached atoms. This state is characteristic of tetravalent carbon compounds involving four electron pair bonds, and is shown to involve an increase of about 7 volts in the internal energy of the C atom over that in the ground state. Because of this increment, the net or observed bonding energy is less than the gross or true inter-atomic bonding energy. The gross energy per bond is probably greater in CH_3 than in CH_4, although the reverse is true of the net. A critical comparison is given of the Slater-Pauling theory of directed valence and the non-directional Heitler-Rumer theory based on a ^5S state of the C atom. The former leads to much firmer bonds. The assumption of electron pairing, made in Part II [see Abstract 2112 (1933)], is shown to be well warranted in CH_4, as it yields an energy value which is very nearly the same as the deepest root of Eyring and colleague's more exact cubic secular equation. The energies of CH_4 and 4CH are compared in the light of theory. AUTHOR.

416. Potassium Superoxide and the Three-Electron Bond. E. W. Neuman. *J. Chem. Phys.* 2. *pp.* 31–33, *Jan.*, 1934.—The highest oxide of potassium is shown to be paramagnetic, with a susceptibility corresponding to the formula KO_2, the crystals being supposed to contain O_2 ions in a $^2\Pi$ state. The electronic structure $: \underset{..}{O} \overset{\cdots}{:} \underset{..}{O} :^-$ is proposed for the superoxide ion. It is suggested that the substance be called potassium superoxide rather than tetroxide. AUTHOR.

417. Apparent Molecular Volumes of Dissolved Electrolytes. Part II. Pressure Coefficient of the Apparent Molecular Volume. W. Geffcken. *Zeits. f. phys. Chem.* 167. *Abt.A.* 3. *pp.* 240–244, *Dec.*, 1933.—It is shown that Gucker's result of the linear dependence of the apparent compressibility of a dissolved salt on the root of the volume concentration, is closely bound up with the analogous Masson-Redlich expression for the apparent molecular volume and may be quantitatively derived at sufficient dilution. The absolute value of the apparent compressibility at infinite dilution may be correctly evaluated from dimensional considerations. [For Part I see Abstract 3664 (1931).] H. H. Ho.

See also Abstracts 425, 436, 468, 469, 491, 580, 604, 624, 656, 669, 691, 712, 811, 844.

COLLOIDS.

418. Mechanism of Formation of Kohlschütter's Silver Sol. H. B. Weiser and M. F. Roy. *J. Phys. Chem.* 37. *pp.* 1009–1018, *Nov.*, 1933.—A suspension of silver oxide in water is reduced at 50–60° C. by H_2 so long as there is excess of silver oxide. It is therefore concluded that reduction occurs at the silver oxide/water interface. Ultrafiltration removes this and sols so treated are not reduced in quartz or silver vessels. On platinum hexagonal plates of silver are deposited owing to catalytic activation of the hydrogen at the metal surface. On glass a thin mirror is formed by reduction of a film of oxide either adsorbed or precipitated at the surface by alkali from the glass. The results show that hydrogen is readily activated by silver oxide surfaces. A. S. C. L.

419. Electrical Double Layer in Colloids. Parts II and III. E. J. W. Verwey and H. R. Kruyt. *Zeits. f. phys. Chem.* 167. *Abt.A.* 1–2. *pp.* 137–163, *Dec.*, 1933.—The determination of the adsorption of peptising ions by positive and negative AgI sols was carried out under various conditions. The changes in the crystalline structure of the particles were investigated by X-ray methods. It was shown that freshly precipitated AgI particles underwent considerable change in structure. The peptising power of ions was not connected with their adsorption tendency. The power of peptising AgI was possessed by ions which specifically influenced potentials. Negative AgI sols, in a state of high purity and of great concentration, were prepared by dialysis and *Elektrodekantierung*. These sols were stable to a high degree. The physico-chemical behaviour of dialysed AgI sols, especially in respect to stability, was intimately connected with a distribution equilibrium of the potential determining iodine ions between the AgI and the solution. [See following Abstract.] F. J. B.

420. Electrical Double Layer in Colloids. Part IV. E. J. W. Verwey and H. R. Kruyt. *Zeits. f. phys. Chem.* 167. *Abt.A.*4. *pp.* 312–328, *Dec.*, 1933.—The coagulation of AgI sol by the adsorption of ions of indifferent electrolytes was studied. The adsorbed amounts of Ce^{3+}, $UO^{2}_{2}{}^{+}$, Ba^{2+}, H^+, Cs^+ were measured for AgI sols, at different concentrations of the electrolytes. Measurements on dialysed AgI sols showed that the taking up of oppositely charged ions by the AgI particles belonged to the type of exchange phenomena. [See preceding Abstract]. F. J. B.

421. Effect of Electrical Waves on Colloids. E. Wilke and R. Müller. *Kolloid Zeits.* 65. *pp.* 257–260, *Dec.*, 1933.—Reference is made to the earlier work of Wilke in 1926 on sols of arsenic trisulphide. It is now shown that the properties of colloids are altered in a h.f. electromagnetic field, e.g. colour, viscosity, coagulation value, cataphoresis and conductivity. A detailed Bibliography is given. J. K.

422. Optics of White Sols. Part III. Optical Properties of Coagulation. T. Caspersson. *Kolloid Zeits.* 65. *pp.* 301–307, *Dec.*, 1933.—The optical phenomena of a coagulating colloid are investigated, but the determination of the dependence of light absorption on particle size is attended by great difficulties. Mie's theory has been developed and an expression has been derived for the change of absorption during coagulation on the assumption of Smoluchowski's theory of coagulation. The expression is of great mathematical complexity and can only be simplified for special cases which are given by experimental data, an example of which is included. [For Part II see Abstract 26 (1934)]. H. H. Ho.

423. Behaviour of Concentrated Ferric Hydroxide Sols in the Capillary Viscometer. A. Rabinerson and G. Fuchs. *Kolloid Zeits.* 65. *pp.* 307–316, *Dec.*, 1933.—Stable concentrated ferric hydroxide sols (content 8–20 % Fe_2O_3 approx.) have been investigated in the pressure viscometer of Bungenberg de Jong, Kruyt and Lens, wherein the pressure could be varied from 15–190 cm. of water. The structural branches are scarcely indicated for new 8·95 % sols, but are developed in the more concentrated and aged sols. In general, the branches are weaker than in most lyophylic colloids. For coagulating ferric hydroxide sols, thixotropy of the resistance has been established. For aged concentrated ferric hydroxide sols in the Hagen-Poiseuille region no true viscosity was established, but an expression has been found for the resistance caused by the structures. It appears probable that structure development is stepwise, primary giving rise later to secondary formations. The critical Reynolds' numbers for concentrated ferric hydroxide sols are lower than that of water, and for 17 % sols are about 13–16 % that of water. It is opined that in the turbulence region the structures are preserved in part. H. H. Ho.

424. Temperature Coefficients of Viscosity of Fluids in Relation to the Structure of Rubber in Solution. W. F. Busse and E. Karrer. *Kolloid Zeits.* 65. *pp.* 211–223, *Nov.*, 1933.—The contents of this paper were delivered to the Rubber Division of the American Chemical Society under the title of "Applications of Dunn's Equation to the Study of Rubber." From the Dunn equation for pure liquids $\log\frac{1}{\eta} = \frac{A}{T} + B$ the equation $\frac{1}{\eta} = KS^{r-1}\epsilon^{-q/kT}$ is derived, based on the assumption that fluidity of a liquid can be represented as a mass, with which is bound up the potential energy of shear on the application of heat. The derived equation combines the equation of Dunn for the relationship of temperature with the viscosity of fluids and the Nutting equation for viscosity and shear. The equation is shown to hold for the reversible changes of viscosity with temperature for rubber solutions of various concentrations in different solvents. If during heating irreversible changes occur then the equation no longer holds. The equation likewise does not hold for ether solutions near the solidification point. It is observed in contradistinction to other workers that the high viscosity of solutions of rubber and other lyophilic colloids cannot be explained on pure chemical solvation or other adsorptive binding of molecules of the solvent. J. K.

See also Abstracts 412, 499.

CRYSTAL STRUCTURE AND PROPERTIES.

425. Second Principle of Crystal Chemistry. A. Kapustinsky. *Zeits. f. Krist.* 86. *pp.* 359–369, *Nov.*, 1933.—The principle enunciated is that the lattice energy of a crystal and therefore the properties associated with it are determined by the number of atoms in the molecule, their dimensions and valency numbers, and in some cases by the polarisation properties of the atoms. A general formula is given from which the lattice energy of any given crystal may be calculated. The principle is applied to the consideration of the energy of morphotropic crystals, the calculation of the ionic radius of tin, the heat of reaction of crystals, the heat of formation of crystals and the heat of solution of crystals. J. T.

426. Amorphous Metallic Layers. H. Zahn and J. Kramer. *Zeits. f. Physik*, 86. 7–8. *pp.* 413–420, *Nov.* 15, 1933.—When amorphous layers of antimony and platinum, obtained by electrolytic deposition, are heated above a certain temperature, they become crystalline. The change is accompanied by a reduction in electrical resistance. The temperature in question is characteristic of the metal and does not depend on the method by which the amorphous modification is obtained, specimens obtained by sputtering and vaporisation exhibiting the change at the same temperature. For antimony this temperature is about 160° C. and for platinum about 222° C. It is shown, from capacity measurements, that the number of free electrons decreases in very thin metallic layers. From this it is concluded that the latter must always be more or less amorphous. J. T.

427. Structure of MgZn and MgZn$_5$. L. Tarschisch. *Zeits. f. Krist.* 86. *pp.* 423–438, *Nov.*, 1933.—Powder photographs demonstrate the existence of MgZn, about which there had previously been some difference of opinion. The structures of MgZn and MgZn$_5$ are deduced. They are derived from the structure of MgZn$_2$ (which is hexagonal) by appropriate replacement of atoms and by doubling the size of the elementary cell in each direction. Both MgZn and MgZn$_5$ exhibit structures in which the Mg and Zn atoms occur in layers at right angles to the c-axis. The actual dimensions of the respective unit cells are as follows. For MgZn, $a = 10 \cdot 66$ Å., $c = 17 \cdot 16$ Å., $c/a = 1 \cdot 61$; and for MgZn$_5$, $a = 9 \cdot 92$ Å., $c = 16 \cdot 48$ Å., and $c/a = 1 \cdot 661$. J. T.

428. Structure of Thallium-Tin Alloys. H. J. C. Ireton, J. P. Blewett and J. F. Allen. *Canad. J. of Research*, 9. *pp.* 415–418, *Nov.*, 1933.—An analysis of the crystal structure of Tl-Sn alloys was carried out.

V. 19

It was found that the tin lattice constant had a maximum value at the eutectic point (42·5 % thallium), while the supraconducting curve showed a cusp-shaped minimum at this point and peak at the solubility boundary. When tin was added to thallium a change from α to β-thallium was observed. This change is similar to that already noted in other alloys of thallium. AUTHORS.

429. Geometry of Mechanical Twin Formation in Zn and Sn. G. Kolesnikow. *Phys. Zeits. d. Sowjetunion*, 4. 4. *pp.* 651–667, 1933.—Geometrical considerations show that, in contrast to the case of α–Fe, no twinning occurs in Zn or Sn by purely mechanical translation of the lattice atoms. The natures of the additional mechanical displacements necessary for twinning to occur are discussed. Their evaluation shows them to be small. H. J. H. S.

430. Structure of $K_2S_2O_6$. M. L. Huggins. *Zeits. f. Krist.* 86. *pp.* 384–388, *Nov.*, 1933. *In English.*—The data given in a previous paper by Huggins and Frank on the structure of $K_2S_2O_6$ are incorrect. The correct values for the parameters of the potassium ions are given and a diagram showing the correct representation of the oxygen distribution is included. This figure now agrees with that of Helwig. F values calculated from the parameters proposed by Huggins and Frank agree at least as well with the experimental data as do those calculated from Helwig's parameters. J. T.

431. Crystallographic Properties of Potassium Penta-Calcium Sulphate. F. Krüll and O. Vetter. *Zeits. f. Krist.* 86. *pp.* 389–394, *Nov.*, 1933.—The compound K_2SO_4, $5CaSO_4$, H_2O is monoclinic, with the following properties: $\alpha = 1\cdot550 \pm 0\cdot003$, $\beta = 1\cdot565$, $\gamma = 1\cdot583 \pm 0\cdot003$. The optical axial angle 2V is approximately 85°. The density at 25° = 2·897. A comparison table is given to contrast these data with the analogous substances anhydrite, syngenite, gypsum. F. I. G. R.

432. Crystal Morphology of Quartz. Parts I, II and III. G. Kalb. *Zeits. f. Krist.* 86. *pp.* 439–465, *Nov.*, 1933.—Morphology in relation to the genesis of quartz, and the importance of vicinal phenomena for the interpretation of penetration twinning. F. I. G. R.

433. Alternating Structure of Cadmium Bromide. J. M. Bijvoet and W. Nieuwenkamp. *Zeits. f. Krist.* 86. *pp.* 466–470, *Nov.*, 1933.—A structure is found in which layers of the $CdCl_2$ and CdI_2 types alternate irregularly. F. I. G. R.

434. Structure of Thallium and Potassium Thiocyanates. W. Büssem, P. Günther and R. Tubin. *Zeits. f. phys. Chem.* 24. *Abt.B.* 1. *pp.* 1–21, *Jan.*, 1934.—In contradiction to published statements, thallous thiocyanate crystallises in the rhombic system, the most probable space-group being $V_h^{\prime\prime}$. The sides of the unit cell are $a = 6\cdot80$, $v = 6\cdot78$ and $c = 7\cdot52$ Å, the symmetry being pseudo-tetragonal. The unit cell contains four molecules and the density is 4·958. In agreement with earlier crystallographic measurements, potassium thiocyanate forms rhombic holohedral crystals, also of space-group $V_h^{\prime\prime}$. The unit cell contains four molecules and has the sides: $a = 6\cdot67$, $b = 6\cdot65$ and $c = 7\cdot54$ Å. T. H. P.

435. Structure of BPO_4 and $BAsO_4$. G. E. R. Schulze. *Zeits. f. phys. Chem.* 24. *Abt.B.* 2–3. *pp.* 215–240, *Jan.*, 1934.—Powder photographs of BPO_4 and $BAsO_4$ show that these substances have the same structure. Laue, rotation and oscillation photographs of $BAsO_4$ are taken ; crystals of BPO_4 large enough for this purpose not being available. The structure is found to be based on a body-centred tetragonal lattice and is related to that of crystobalite, the space group being S_4^2. There are two molecules in the unit cell and the lattice constants are as follows :

$BPO_4 : a = 4 \cdot 332 \pm 0 \cdot 006$ Å., $c = 6 \cdot 640 \pm 0 \cdot 008$ Å., $c/a = 1 \cdot 533 \pm 0 \cdot 014$
$BAsO_4 : a = 4 \cdot 458 \pm 0 \cdot 006$ Å, $c = 6 \cdot 796 \pm 0 \cdot 008$ Å, $c/a = 1 \cdot 525 \pm 0 \cdot 014$

The density of BPO_4 is found to be 2·802 and that of $BAsO_4$ to be 3·660. The oxygen parameters are given, the other atoms being without parameter. BPO_4 and $BAsO_4$ are doubly refracting and the refractive indices and molar refraction for the sodium D line are determined. J. T.

436. Structure of the Hypophosphite Group as Determined from the Crystal Lattice of Ammonium Hypophosphite. W. H. Zachariasen and R. C. L. Mooney. *J. Chem. Phys.* 2. *pp.* 34–37, *Jan.*, 1934.—The crystal structure of ammonium hypophosphite was examined in order to determine the size and shape of the hypophosphite group. The crystals are orthorhombicholohedral with the dimensions of the unit cell ; $a = 3 \cdot 98$ Å, $b = 7 \cdot 57$ Å, $c = 11 \cdot 47$ Å. There are 4 molecules $NH_4(H_2PO_2)$ in the cell, and the space group is *Acmm* (Vh^{21}). The complete structure is given. The parameter values for phosphorus and oxygen were determined directly from the observed intensities of reflections, whereas the hydrogen values are based upon reasonable assumptions. The hypophosphite group has the shape of a distorted tetrahedron ; two of the tetrahedral corners being occupied by O atoms and the other two by H atoms. The phosphorus to oxygen distance is 1·51 Å and the angle between the phosphorus to oxygen bonds 120°. The distance from phosphorus to hydrogen is 1·5 Å and the angle between the P – H bonds 92°. Each ammonium radical is surrounded by four O atoms at a distance of 2·81 Å and by four H atoms at a distance of 3·08 Å. There is strong indication that the ammonium radical is not rotating, and that H atoms of the NH_4-groups are linked to the surrounding oxygen atoms as well. The H atoms of the hypophosphite group behave toward ammonium as if they were H-ions. AUTHORS.

437. Liquid Crystals from Aqueous Solutions of Tartrazine. P. Gaubert. *Comptes Rendus,* 197. *pp.* 1436–1438, *Dec,* 4, 1933.—On cooling or evaporating solutions of the dyestuff tartrazine liquid crystals of both nematic and smectic types are formed. The stability and appearance of these are modified by traces of impurities. A. S. C. L.

438. Alteration in the Properties of a Polycrystalline Material on Recovery. M. O. Kornfeld. *Phys. Zeits. d. Sowjetunion,* 4. 4. *pp.* 668–674, 1933.—The annealing of a deformed polycrystalline specimen of aluminium in the region of pure recovery (*i.e.*, in the absence of recrystallisation) does not restore the original properties of the material. The yield points are measured after recovery for several hours at various temperatures between 250 and 350° C. and are shown to be higher than in the original material. Evidence is adduced to show that this change is due to intergranular disturbances. H. J. H. S.

439. Flow Conditions of Crystals. W. Boas and E. Schmid. *Zeits. f. Physik,* 86. 11–12. *pp.* 828–830, *Dec.* 6, 1933.—The question whether the yield point of crystals is determined by their subjection to a constant shear stress or to a constant elastic slip of the translation system is considered. Reasons are given in favour of the shear stress. R. L.

440. Deformation of Differently Orientated Cd Crystals. W. Fahrenhorst and H. Ekstein. *Zeits. f. Metallkunde*, 25. *pp*. 306–308, *Dec*., 1933.—The work on Zn and Sn crystals [see Abstract 647 (1931)] is extended to the case of Cd. Single crystals of Cd are rapidly oscillated through a small angle in a suitable torsional machine and examination after about 100,000 oscillations shows a deformation (ribbed structure) of the crystal which is detectable microscopically and by X-ray analysis. The mechanism of the deformation for crystals of different orientations is discussed, and a method of calculating the shape of a crystal of definite orientation is given. H. J. H. S.

441. X-Ray Goniometer. E. Schiebold. *Zeits. f. Krist.* 86. *pp*. 370–383, *Nov*., 1933.—The universal X-ray goniometer described by Sauter [see Abstract 2156 (1933)] is identical in principle with one described by the author in 1930 and used by him since. A description of the apparatus is given. The construction of a new model is described and the methods of using it are outlined. J. T.

442. Apparatus for X-Ray Analysis. W. E. Schmid. *Zeits. f. phys. Chem.* 23. *Abt.B.* 5–6. *pp*. 347–357, *Dec*., 1933.—By the use of the type of tube described (a Siemens-Halske), which has a circular focus, and cameras of an appropriate pattern, the time of exposure for Debye-Scherrer photographs can be appreciably reduced. The cameras are easily adjusted and can be replaced by other patterns for various purposes. J. T.

443. Rotating-Crystal Camera. E. Sauter. *Zeits. f. phys. Chem.* 23. *Abt.B.* 5–6. *pp*. 370–378, *Dec*., 1933.—The author's universal X-ray camera is described. It can be used as an X-ray goniometer, and the rotating-crystal photographs so obtained are such that the indices corresponding to the various reflections can be read off at once. J. T.

444. Lattice Constants, 1933. M. C. Neuburger. *Zeits. f. Krist.* 86. *pp*. 395–422, *Nov*., 1933.—Tables are given of the following data: Lattice types, purity, lattice constants, periodic system, radii (Goldschmidt), together with a Bibliography. F. I. G. R.

See also Abstracts 412, 454, 581, 582, 706, 707, 840.

DENSITY.

445. Density and Refractive Index at High Temperatures. G. Pesce and P. Hölemann. *Zeits. f. Elektrochem.* 40. *pp*. 1–5, *Jan*., 1934. —(1) The upper end of a special pycnometer terminates in a thick neck pierced by a capillary tube and finished to a horizontal polished flat on which slides the polished surface of a glass cover. A cap encloses the cover. A capillary at the bottom of the pycnometer terminates in a fine jet delivering downwards. The whole is immersed in a thermostat and the jet passes through a ground glass joint into a vessel in which is a small beaker which can be brought up under the jet for the purpose of adjusting the quantity of the liquid in the pycnometer or of collecting for weighing any liquid expelled. The capillary, and the lower portion of the pycnometer, are filled with mercury and the rest of the pycnometer is filled with the liquid whose density is required. By appropriate weighings the density of the liquid is determined. The expansion of the liquid is determined by gradually raising the temperature and weighing the expelled mercury. The method has the advantages that the liquid is totally enclosed and the use of mercury results in a magnification of about 13 in the weighings of the expelled liquid. Densities of CCl_4 up to 65° C. and acetic acid up to 85° C. are quoted. The maximum difference from the mean at a given temperature is less than 0·00002 gm./cm.^{3}. (2.) The refractive index of water up to 85° C. for wave-lengths 6563 Å to 4358 Å was determined by means of a Pulfrich refractometer with adequate temperature control. A special cement was used. The accuracy of determination of the refractive index was 1 to 2×10^{-5} irrespective of temperature. P. H. B.

See also Abstracts 435, 505, 712, 728, 729, 732.

DIFFUSION AND OSMOSIS.

446. Influence of Magnetic Fields on the Diffusion of Paramagnetic Gases. H. Senftleben. *Phys. Zeits.* 36. *pp.* 835–836, *Nov.* 15, 1933.—From former papers on the influence of magnetic fields on the conduction of heat in gases the author deduced that a magnetic field should also affect the diffusion of a paramagnetic gas in a diamagnetic gas. The change in the rate of diffusion should amount to a few thousandths at the maximum. A very sensitive method of detecting the change has been devised by the author, a variation of one ten-thousandth being observable. Measurements carried out with carbon tetrachloride diffusing into oxygen confirmed the expected result quantitatively but the order of magnitude is less than had been calculated on the basis of the data obtained from heat conduction. H. L. B.

447. Diffusion of Potassium into Glass. B. v. Lengyel. *Zeits. f. phys. Chem.* 167. *Abt. A.* 4. *pp.* 295–311, *Dec.*, 1933.—The diffusion of potassium into glass, from various potassium salts, was investigated. The diffusion was measured by conductivity measurements and by weighing powdered glass which had been in contact with the molten potassium salt. The two were heated together to 390° C. for some hours. After cooling the potassium salt was removed by washing and the gain in weight of the glass was observed. The diffusion was found to follow Fick's law. F. J. B.

448. Diffusion of Gases into Solids. H. Dünwald and C. Wagner. *Zeits. f. phys. Chem.* 24. *Abt.B.* 1. *pp.* 53–58, *Jan.*, 1934.—When the pressure of a gas in contact with a solid is increased, both a chemical reaction at the bounding surface, and a diffusion of the gas into the solid may be observed. Formulæ giving the variations of both effects with time, are produced, and methods suggested whereby the coefficient of diffusion of the gas into solids of certain special shapes might be determined. J. P. A.

See also Abstracts 408, 701.

ELASTICITY AND PLASTICITY.

449. Strain Energy in an Elastic Bar. E. H. Bateman. *Phil. Mag.* 16. *pp.* 1128–1131, *Dec.*, 1933.—When a plane elastic network formed of end-connected bars is to be analysed by Castigliano's method of minimum strain-energy, the indeterminate quantities may be the bending moments in the bars at the connections. In this case, an expression for the strain energy can be given in terms of the indeterminate quantities without having to operate on a general expression for the bending moment at any point in the bar. This proposition is proved for the cases (*a*) when no other forces appear, and (*b*) when the bar carries any form of transverse load distribution. J. P. A.

450. Stresses Induced by Flexure in a Deep Rectangular Beam. D. B. Smith and R. V. Southwell. *Roy. Soc., Proc.* 143. *pp.* 271–284, *Jan.* 1, 1934.—In St. Venant's well-known solution of the problem of flexure, terminal couples applied to a cylinder of isotropic material induce stresses which are purely longitudinal. It is evident that this solution cannot be exact, because radial forces are required to maintain tension or compression in a longitudinal fibre which is bent into a circular arc. The explanation of the apparent paradox is that these radial forces are of the second order in terms of the curvature, and as such are neglected in St. Venant's approximation. Regarded as an example of " plane stress," the special case of a thin flat strip bent in its own plane can be treated by exact methods which involve no simplifying assumption, and the resulting equations are integrable. St. Venant's solution results as a first approximation, when quantities of the second order in terms of curvature are neglected ; and the second approximation (neglecting quantities of the third order) agrees very closely with the exact solution throughout the range of curvatures which could be realised in actual materials without impairing their elasticity. AUTHORS.

451. Modulus of Elasticity of α Bronzes in the Annealed State. L. Guillet, Jr. *Comptes Rendus,* 197. *pp.* 1320–1322, *Nov.* 27, 1933.—Experiments are described for the accurate determination of Young's modulus for various bronzes. A table of the results shows that Young's modulus diminishes linearly (to a first approximation) with increasing tin content. R. L.

452. Isothermals of Helium at Temperatures of 0, 20 and 100° C., and Pressures from 5·5 to 16·5 Atmospheres. W. H. Keesom and J. J. M. van Santen. *K. Onnes Lab., Leiden, Comm. No.* 227*b*. *K. Akad. Amsterdam, Proc.* 36. 9. *pp.* 813–821, 1933.—For the sake of thermometry, especially for a more accurate ascertaining of the position of the ice point on the Kelvin-scale, it was resolved some years ago that very careful redeterminations should be made, of the fundamental pressure coefficient of helium on the one hand, of the isothermals of helium at 0° and 100° C. on the other hand. This paper contains the results of the last mentioned investigation. They are

$$B_{0^\circ\mathrm{C.}} = 0{\cdot}502^{8} \times 10^{-3},\ B_{20^\circ\mathrm{C.}} = 0{\cdot}498^{9} \times 10^{-3},\ B_{100^\circ\mathrm{C.}} = 0{\cdot}481^{4} \times 10^{-3}.$$

The value $B_{100^\circ\mathrm{C.}} - B_{0^\circ\mathrm{C.}} = -0{\cdot}021^{4} \times 10^{-3}$ is estimated to have a mean error $\pm 0{\cdot}005 \times 10^{-3}$. AUTHORS.

453. Mechanism of Plastic Deformation. A. W. Stepanow. *Phys. Zeits. d. Sowjetunion,* 4. 4. *pp.* 609–627, 1933.—A more detailed account, including a description of the apparatus, of work previously recorded [see Abstract 2176 (1933)]. J. P. A.

454. Plasticity of Rock-Salt and Its Dependence upon Water. R. B. Barnes. *Phys. Rev.* 44. *pp.* 898–902, *Dec.* 1, 1933.—Measurements are reported which show that if a piece of rock-salt be placed in water, the water actually penetrates into the interior of the crystal. A discussion is given of the rôle played by the water in causing the high degree of plasticity and tensile strength (Joffé effect) characteristic of salt crystals which have been so treated. AUTHOR.

455. Mechanical Properties of Metals and Alloys at Liquid Hydrogen Temperatures. W. J. de Haas and R. Hadfield. *Roy. Soc., Phil. Trans.* 232. *pp.* 297–332, *Dec.* 6, 1933.—The mechanical properties of 41 specimens of metals and alloys are investigated at −252° C. At this temperature, iron, ordinary steel and most alloys of iron lose all ductility, whereas Fe-Ni alloys containing a high percentage of Ni remain remarkably ductile. The mechanical properties of Ni, Cu, Al, are improved at the lower temperature. The usual effect of low temperature in increasing the tenacity of metals and alloys appears to have reached a limit between −182° and −252·8° C. The results of exposing the specimens to the low temperature are generally only temporary, except in the cases of certain high percentage Ni-Fe alloys already known to change irreversibly at these temperatures. The observations are discussed in detail. J. P. A.

456. Latent Energy Remaining in a Metal after Cold Working. G. I. Taylor and H. Quinney. *Roy. Soc., Proc.* 143. *pp.* 307–326, *Jan.* 1, 1934.—Measurements of the latent energy remaining in metal rods after severe twisting are described. Very much more cold work can be done on a metal in torsion than in direct tension. It is found that as the total amount of cold work which has been done on a specimen increases the proportion which is absorbed decreases. Though saturation was not fully reached even with twisted rods, curves representing the experimental results for copper indicate that it would have been reached at a plastic strain very little greater than the strain at fracture. The amount of cold work necessary to saturate copper with latent energy at 15° C. is thus found to be slightly greater than 14 cal. per gm. By using compression instead of torsion, it was found possible to do much more cold work on copper than this, and compression tests revealed the fact that the compressive stress increases with increasing strain till the total applied cold work was equivalent to 15 cal. per gm. No further rise in compressive stress occurred with further compression even though the specimen was compressed till its height was only 1/53rd of its original height. The fact that the absorption of latent energy and the increase in strength with increasing strain both cease when the same amount of cold work has been applied suggests that the strength of pure metals may depend only on the amount of cold work which is latent in them. AUTHORS.

457. Physical Properties of the Photoelastic Material "Phenolite." M. Nisida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 467. *pp.* 269–283, *Nov.*, 1933. *In English.*—Five test pieces of "phenolite" which had been subjected to different heat treatment are tested photoelastically under uniform bending moment. Both optical and mechanical creep are observed depending on the heat treatment of the material. The smaller the elastic constant E the greater is the creep. A linear relation is found between optical and mechanical creep and the slopes of these lines correspond with the hardness of the material. Log α (α = optical sensibility) is plotted against log T (T = time) and the resulting curves are in the form of a bent line for each different specimen. No formula has been found to fit these curves. R. L.

458. Suitability of Materials for Photoelastic Investigations. R. B. Carleton. *Rev. Sci. Instruments,* 5. *pp.* 30–32, *Jan.*, 1934.—Glass, celluloid, cellulose acetate, hard and soft rubber and seven synthetic resins have been tested to determine their suitability for photoelastic investigations. The stress-strain relations, photoelastic coefficients and annealing temperatures have been measured. It is concluded that the synthetic resins Phenolite, Bakelite, and L'Orca are among the most satisfactory materials for photoelastic purposes. AUTHOR.

459. Electrical Recording Extensometer. F. de la C. Chard. *Engineering*, 136. *pp.* 699–700, *Dec.* 29, 1933.—In the circuit described a change in length causes two electrical capacities to change differentially giving a large current variation for a given change of length. Amplification is by a three valve amplifier with a pentode output stage, and recording by a Matthews moving-iron oscillograph. A length change of 10^{-5} in. gives a full deflection of the recording instrument. The amplifier allows a very wide range of sensitivity. Thus by cutting out one valve a change of 5×10^{-2} in. may be fully recorded. The whole instrument is designed so as to be easily portable, suitable for field work and able to be operated by those unaccustomed to using oscillographs. R. L.

460. Solidification Phenomena in Metallic Powders. W. Trzebiatowski. *Zeits. f. phys. Chem.* 24. *Abt.B.* 1. *pp.* 75–86, *Jan.*, 1934.—Copper and gold powders, in extremely fine states of division, were compressed into thin rods and plates. The pressure employed was 30×10^3 atmospheres as a maximum. The hardness and the density of the samples were determined, and the X-ray diagrams were examined for evidence of solidification. Considerable solidification was observed, as shown by the broadening of the interference lines and the increase of the scattering of the rays. Re-crystallisation and loss of hardness were observed after annealing in a vacuum. F. J. B.

See also Abstracts 417, 440, 466, 704, 719, 732.

GRAVITATION.

461. Relative Gravity Determination by Means of Short Radio Waves. M. Kimura. *Imp. Acad. Tokyo, Proc.* 10. *pp.* 370–373, *Oct.*, 1933. *In English.*—For relative determinations of gravity one of the main sources of error is the undertainty in the time rate of the chronometer. In the method described wireless signals are transmitted twice for every oscillation of a ½-second brass pendulum at the base station and received by an auto-dyne three tube set at the field station. These intercepted signals interrupt regularly a light beam which is focussed on a slowly moving photographic film. Silica and brass pendulums are first compared at the base station and the former taken to field stations in turn for further comparison. In this method irregularity in the time lag of the coincidence apparatus behind the received signal at the field station is the main source of error but this can be avoided by using the glow from the mercury vapour in a thyratron as a direct source of light. R. S. R.

462. Gravity Measurements at Sea on Board an Ordinary Vessel. C. Tsuboi. *Imp. Acad. Tokyo, Proc.* 10. *pp.* 374–377, *Oct.*, 1933. *In English.*—The author devised an apparatus in which the two isochronous gravity pendulums used are made to swing in parallel planes, but in opposite phases, with their knife edges on the same straight line A. The case containing the pendulums is mounted on a frame which rotates very slowly about a horizontal axis perpendicular to A. The oscillations of a light beam, indicating differences in the oscillations of the two pendulums, are recorded on a photographic film. The light beam is interrupted every second by a screen driven electrically by means of a chronometer. The apparatus is installed on a ship in such a way that the rolling does not affect the oscillations while corrections are applied for the pitching. Preliminary tests have given satisfactory results on the Sagami Bay. A more complete form of apparatus is being constructed and further tests are to be made. R. S. R.

See also Abstract 540.

HYDRODYNAMICS AND AERODYNAMICS.

463. Upward Speed of an Air Current Necessary to Support a Hailstone. G. Grimminger. *Monthly Weather Rev.* 61. *pp.* 198–200, *July,* 1933.—Humphreys and Simpson have computed the upward air speed necessary to support a hailstone and employed it to obtain the upward air speed in a thunderstorm. The author supplements these calculations by allowing for fine grained turbulence in the air stream. For an assumed air density he obtains a table giving for hailstones 1 to 5 inches in diameter the upward air speed required to support them with (1) much turbulence, (2) little turbulence, and (3) very little turbulence. For a hailstone of 2 in. diameter the range of speed is 78 to 206 m./hr. Variations in turbulence, in addition to changes in air speed, may produce differences in the vertical velocity. The degree of turbulence in the free air is also discussed. R. S. R.

464. Oscillations of a Solid Body in Air and in Water. L. Marty. *J. de Physique et le Radium,* 4. *pp.* 557–569, *Oct.,* 1933.—The author gives a treatment of the theory of the oscillatory flow of an incompressible fluid. He then applies this to the movement of the fluid surrounding a body which is vibrating, taking separately the cases in which the fluid is respectively air and water. He shows that the compressibility of the fluid does not enter into the problem. The theory explains the existence of zones of silence. J. W. T. W.

465. Stream Lines in Air Jet. D. Riabouchinsky. *Comptes Rendus,* 197. *pp.* 1589–1591, *Dec.* 13, 1933.—Discusses the mathematical treatment of the lines of emission of air flowing through a bevelled hole in a flat plate and the explanation previously given of the autorotation which takes place under these conditions. J. W. T. W.

466. Free Oscillations of an Immersed Hollow Cylinder. K. Federhofer. *Akad. Wiss. Wien, Ber.* 142. 2a. 5–6. *pp.* 201–206, 1933.—An infinitely long, narrow, and thin-walled cylinder is immersed deeply in an ideal fluid. The frequencies of vibration for this cylinder, and for the special case of a solid cylinder, are worked out. The frequencies of the hollow cylinder are much more diminished by the presence of the surrounding fluid, than those of the solid cylinder. J. P. A.

467. Optical Method of Investigating Bidimensional Velocities. C. Sadron. *Comptes Rendus,* 197. *pp.* 1293–1296, *Nov.* 27, 1933.—An experiment is described whereby the relation $n_\alpha - n_\beta = \mu \mathrm{B} du/dn$, between the double refraction, $n_\alpha - n_\beta$, exhibited by a moving liquid of viscosity μ, and the rate of change, du/dn, of its velocity u, along a line $\perp$ to such direction of motion and to the beam of light is used to investigate this rate of change in velocity. (B is Maxwell's constant.) C. A. S.

See also Abstracts 550, 551.

KINETIC THEORY OF MATTER.

468. Collision Areas of 1 : 3 : 5-Mesitylene and of the Most Highly Branched Heptanes. W. A. Everhart, W. A. Hare and E. Mack, Jr. *Am. Chem. Soc., J.* 55. *pp.* 4894–4897, *Dec.*, 1933.—The viscosities of the vapours of 1 : 3 : 5-mesitylene and 2 : 2 : 3-trimethylbutane have been measured over a considerable temperature range, and the Sutherland constants and collision areas, respectively, 136·3 and 257, and 42·4 and 31·1 sq. Å, have been calculated from the data. The shadowgraphically computed collision areas of the models to scale, are 42·7 for mesitylene and 29·5 (or 30·8) for the heptane. These good matches between calculated and observed results are submitted as still further evidence for the reliability of this general method of determining spatial configuration of organic molecules. A type of space isomerism similar to that found in diphenyl is predicted for 2 : 2 : 3-trimethylbutane and for hexamethylethane. H. H. Ho.

469. Stern-Gerlach Experiment with Iron. W. Klabunde and T. E. Phipps. *Phys. Rev.* 45. *pp.* 59–61, *Jan.* 1, 1934.—An atomic ray of iron was investigated by the method of Stern and Gerlach. The intensity of the ray was sufficient to make the deposit upon the target directly visible in the vacuum after many hours. The trace was found to be widened when the ray was subjected to the magnetic field, an indication that iron in the vapour state has a magnetic moment. This positive result may remove the apparent discrepancy between spectroscopic prediction and the original negative result of Gerlach. AUTHORS.

470. Brownian Movements. M. Satô. *Zeits. f. Physik*, 86. 9–10. *pp.* 667–674, *Nov.* 28, 1933.—Brownian movements are discussed, by Sommerfeld's integration methods, from the standpoint of Fermi-Dirac statistical theory. Brownian movement in the Einsteinian sense only takes place when the gas is not in a quantised condition. For strongly quantised gas there emerges a new datum differing widely from that of the classical theory. Planck's constant *h* can be found directly by measurement of the Brownian movement in a strongly quantised gas. A. D.

See also Abstract 644.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

471. Tchebycheff Polynomials and Their Relation to Circular Functions, Bessel Functions and Lissajous Figures. B. van der Pol and T. J. Weijers. *Physica*, 1. *pp.* 78–96, *Dec.*, 1933.—It is usual to approximate an experimental function by a polynomial and this polynomial expression must then be fitted to the experimental data. Tchebycheff uses an approximation which is defined in such a way that in the domain considered, the absolute value of the maximum deviation between the experimental curve and the approximation (*e.g.*, in the form of a polynomial of a given degree) shall be as small as possible. Approximations in this sense can be constructed also to give analytical functions. This study of Tchebycheff polynomials resulted from a general investigation into the best approximation to triode characteristics. In the present paper the general properties of Tchebycheff polynomials are explained mathematically and their relations to circular functions, Bessel functions and Lissajous figures. The application of these polynomials to an approximate representation of triode characteristics is to be dealt with in a later paper. R. S. R.

472. Limitations to Accuracy of Measurement. M. Czerny. *Zeits. f. techn. Physik*, 14. 11. *pp.* 436–440, 1933.—Discusses these limitations in optical appliances. Shows that the accuracy of electric measurements is limited by thermodynamic oscillations. Discusses the limitations of the acuteness of sight and of hearing. A. D.

473. Recording of Variable Phenomena. R. Vieweg. *Zeits. f. techn. Physik*, 14. 11. *pp.* 441–447, 1933.—A discussion of automatic recording and the needful appliances, including drum and pen, scratching points, light-beams, photoelectric methods, electron streams, photographic adjuvants, and statistical methods. A. D.

See also Abstracts 405, 477, 478, 612, 747.

MECHANICS, CLASSICAL.

474. Application of Liapunow's Theory of Stability. A. Andronow and A. Witt. *Phys. Zeits. d. Sowjetunion*, 4. 4. *pp.* 606–608, 1933.—The following theorem is proved : Periodic solutions of a system of n independent differential equations, explicit with respect to time, are stable in the sense of Liapunow, when the n-1 characteristic exponents of the disturbance equation of the first order possess negative real members. H. H. Ho.

475. Complete Evolution of a Non-Uniform Rotating Mass. A. Véronnet. *Comptes Rendus*, 197. *pp.* 1287–1289, *Nov.* 27, 1933.—It is shown that the various figures which a rotating non-homogeneous mass can assume, can be worked out in detail. Such a mass cannot split into two when the speed of rotation increases, there being continuity throughout the whole series of equilibrium figures. G. C. McV.

476. Uniform Integrals in the Problem of Three Bodies.—J. Chazy. *Comptes Rendus*, 197. *pp.* 1391–1393, *Dec.* 4, 1933.—The domains in which the well-known integrals of the problem of three bodies are uniform are precisely defined. G. C. McV.

477. Precession in Gyroscopic Phenomena. A. Métral. *Comptes Rendus*, 197. *pp.* 1582–1584, *Dec.* 18, 1933.—The author refers to the methods used by Halphen and Hadamard to prove that precessional rotation always has the sign of the initial value r_0 of the component of the rotation of the solid of revolution around its axis of figure when the precessional speed is annulled in the course of the movement. In a paper a more simple mathematical demonstration of this result is provided while remaining in the real domain and using Puiseux's demonstration relative to the spherical pendulum. R. S. R.

478. Integration with a Single Quadrature of the Movement of Regular Precession. S. Minetti. *Comptes Rendus*, 197. *pp.* 1584–1586, *Dec.* 18, 1933.—From a study of the geometry of holospaces and their connection with the theory of ordinary differential equations the author found a case where integration of Riccati's equation is obtained with the help of a single quadrature. The mathematical results are applied to a movement of regular precession and to one where the precession ceases to be regular but the geometrical type of the movement is always the same. R. S. R.

479. Pendulum Oscillations with Damping Proportional to the Square of the Velocity. A. Willers. *Zeits. f. Instrumentenk*, 53. *pp.* 504–506, *Dec.*, 1933.—A solution is obtained of the motion represented by the equation: $\ddot{\chi} \mp \frac{\lambda}{2}\chi^2 + a^2 \sin\chi = 0$, for an angular displacement χ. Special conditions are considered which give oscillations which are aperiodic or periodic. If λ is large, then the motion is so slow that the second term becomes negligible and an almost undamped vibration results. H. M. B.

See also Abstract 481.

MECHANICS, QUANTUM.

480. Nature of Waves and Corpuscles. E. Sevin. *Comptes Rendus*, 197. *pp.* 980–982, *Oct.* 30, 1933.—A simple expression is derived for the kinetic energy of an electron in terms of the factor, $h\nu/m_0c^2$, where ν is the associated wave-mechanical frequency; this expression is inserted in Schrödinger's equation, which is formulated in its most general form. The Compton effect is discussed from the point of view of a specially defined coefficient of stability. This coefficient is very great in the case of cosmic rays but becomes very small for X-rays. H. L. B.

481. Hydrogen-Type Atoms in the Old Quantum Theory. P. Copel. *J. de Physique et le Radium*, 4. *pp.* 638–645, *Nov.*, 1933.—The two-body problem is treated, using as a parameter the eccentricity anomaly of classical mechanics and an analogous parameter in relativistic mechanics. The quantisation is thereby simplified for determining energy and paths of motion. N. M. B.

482. Electronic Flux in the Many-Electron Problem. J. Winter. *J. de Physique et le Radium*, 4. *pp.* 646–649, *Nov.*, 1933.—In the problem of *n* electrons the influence on flux of the summations of terms introduced by the Pauli principle is considered. It is found that to zero approximation no correction is necessary, but to a first approximation corrective terms must be introduced. N. M. B.

483. Relativistic Theory of the Dirac Electron in a Nul Field. A. Proca. *Ann. de Physique*, 20. *pp.* 347–440, *Nov.*, 1933.—The presentation of a relativistic form of Dirac's theory is approached by the removal of the privileged function of "time," and the introduction of a "proper time" analogous to classical proper time. Dirac operators for the free motion of an electron are simplified and classified, and the functions of a new type of ternary operator are developed. These are interpreted physically in relation to classical kinetic moment. The case of an electron described by a plane wave is dealt with in full; it is postulated that such an electron can be completely described by two vectors at right angles, one describing its motion of translation, and the other its rotation. The case of an electron in various states and a wave packet introduces a charge and a "free magnetic current" due to transitions between coexistent states. N. M. B.

484. Fundamental Laws of the de Broglie Waves and the Gravitation Theory of de Donder. J. Géhéniau. *Comptes Rendus*, 197. *pp.* 1393–1395, *Dec.* 4, 1933.—A general wave-equation proposed by de Donder is shown to give the well-known results concerning velocity, frequency and group-velocity of the de Broglie electron waves. G. C. McV.

485. Dirac's and Jacobi's Equations. J. van Mieghem. *Comptes Rendus*, 197. *pp.* 1289–1291, *Nov.* 27, 1933.—In a suitably chosen five-dimensional space, the Jacobi equation is shown to be that of the characteristics of the Dirac equation. G. C. McV.

486. Double and Triple Levels. F. J. Wisniewski. *Acta Physica Polonica*, 2. 2. *pp.* 219–223, 1933. *In French.*—On the basis of different conditions being represented by different solutions of the equation $\nabla^2 V=0$, works out a series of data for different levels [see Abstract 1753 (1933)]. A. D.

487. Quantum Theory of the Electromagnetic Field. M. Born. *Roy. Soc., Proc.* 143. *pp.* 410–437, *Jan.* 1, 1934.—Difficulties associated with the development of the quantum theory of the electromagnetic field are briefly discussed, and the author attempts to develop a field theory, agreeing with reality and based on a generalisation of the approved principles of quantum mechanics. It is shown that Maxwell's equations in their original form are not compatible with the suggested quantum laws; they have to be replaced by equations which are a special form of those in Mie's general field theory. The existence of an electron of finite radius and finite energy, and whose potential function for large distances agrees with Coulomb's law is deduced. This electron behaves in external fields like the classical point-charge provided the field is almost constant in a region large compared with electronic dimensions. J. S. G. T.

488. Determination of the Planck Constant from Measurements of the Velocity of Photoelectrons. S. Priležaev. *Zeits. f. Physik*, 87. 1–2. *pp.* 28–31, *Dec.* 13, 1933.—A reply to criticisms of a previous paper by Lukirsky and Priležaev [see Abstract 1301 (1929)] made by DuBridge [see Abstract 3249 (1933)]. C. B. A.

See also Abstracts 411, 470, 489, 626, 818.

RELATIVITY AND ETHER.

489. Spinors in Projective Relativity. O. Veblen. *Nat. Acad. Sci., Proc.* 19. *pp.* 979–989, *Nov.*, 1933.—The theory of spinors is developed from the purely geometrical point of view and is reduced to the theory of projective relativity by the specification of certain fundamental spinors. G. C. McV.

490. Unified Field Theory. Part I. Electromagnetic Field. D. Meksyn. *Phil. Mag.* 17. *pp.* 99–112, *Jan.*, 1934.—A unified field of two particles can be represented by an eight-dimensional space, whose metric satisfies Einstein's law of gravitation $G_{\mu\nu}=0$. The electrostatic potential is simply connected with the fundamental tensor, but the vector potential and the electromagnetic force have no metrical meaning. The eight-dimensional space does not describe the most general electromagnetic field, but it includes the cases of an electrostatic and constant magnetic fields. The law of motion and the connection between the two times is given by the geodesic of space. Two particles of charges e, E and masses m, M, exert on each other a repulsive force with a potential $1/4(1/m + 1/M)e^2E^2/c^2r^2$. AUTHOR.

See also Abstract 487.

SOLUTION.

491. Partition of Associating Substances. H. J. Almquist. *J. Phys. Chem.* 37. *pp.* 991–994, *Nov.*, 1933.—Distribution and association constants are calculated and compared with experimental values for a number of substances in water and various organic solvents. A. S. C. L.

492. Electrostatic Theory of Ionic Equilibria in Aqueous Solution. J. W. Chodakow. *Zeits. f. phys. Chem.* 24. *Abt.B.* 1. *pp.* 35–52, *Jan.*, 1934.—A discussion is given of the physical basis of a new approximate theory of ionic equilibria in aqueous solutions. The theory is related to Kossel's theory but differs from it in its fundamental postulates, most important among which is the so-called "*Monolithätspostulat*" that a polyatomic ion is electrostatically equivalent to a simple monatomic ion of the same radius and charge. Equilibria are treated by the introduction of an energy characteristic, which is of electrostatic origin and differs from purely thermodynamic characteristics in that it involves the constitution of the molecular species taking part in the equilibrium. Thus by means of the theory qualitative conclusions as to ionic equilibria can be drawn from the crystallographic values of the ionic radii. A number of familiar cases is considered and good agreement is obtained with fact. Conversely, values of the " chemical " ionic radii can be calculated by the theory from purely chemical data (dissociation constants, etc.). Actually agreement with the crystallographic values is obtained to within 3 to 4 %. L. A. W.

493. Solubilities of Inorganic Salts in Liquid Ammonia at − 33·9° C. W. C. Johnson and O. F. Krumboltz. *Zeits. f. phys. Chem.* 167. *Abt.A.* 4. *pp.* 249–259, *Dec.*, 1933.—A short description is given of a direct method of determining solubilities in liquid ammonia at − 33·9° C. Constancy of temperature is obtained by means of a bath of liquid ammonia at controlled vapour pressure. An electromagnetic stirrer is used to ensure equilibrium between solid and liquid within the closed apparatus and the sample for analysis is hoisted up through a wide-bore tap by means of an externally operated winch device. Experimental results are tabulated for the salts: NaCl, NaBr, KCl, KBr, KAc, KCN, NH_4Cl, NH_4Br, LiCl and AgCl. The greatest deviation from the mean is ½ % for the more soluble and about 3 % for the less soluble salts. L. A. W.

See also Abstracts 604, 810.

SURFACE TENSION AND COHESION.

494. Effect of Dissolved Electrolytes on the Boundary Tension of Water. W. G. Eversole and D. S. Dedrick. *J. Phys. Chem.* 37. *pp.* 1205–1214, *Dec.*, 1933.—By means of a specially designed apparatus the drop volume method of measuring interfacial tensions has been employed to yield very accurate results. The effect of sodium acetate and of sodium formate on the interfacial tension of oil–water systems is very different from that of the free acids. An attempt to explain the effect of these salts has been made on the basis of the Langmuir theory of molecular orientation and the increased interionic attraction in the interface due to the dielectric constant gradient in the interfacial layer. The effect of strong electrolytes in general on boundary tension may be explained in a similar manner. [See following Abstract.] AUTHORS.

495. Interfacial Tension of Benzene-Water System. D. S. Dedrick and M. H. Hanson. *J. Phys. Chem.* 37. *pp.* 1215–1221, *Dec.*, 1933.—Accurate measurements have been made of the effect of dissolved sodium acetate on the interfacial tension of the water-benzene system. The curve obtained by plotting the interfacial tension of this system against the concentration of sodium acetate shows, at high concentrations, a secondary tension lowering effect which has not been observed in previous work. The theory of Eversole and Dedrick [see preceding Abstract] has been extended to include the boundary effects of strong electrolytes at higher concentrations. The effects noted in this work appear quite analogous to those described by Taylor in his theory of activated adsorption of gases by solids [see Abstract 2470 (1931)]. AUTHORS.

496. Surface Tension of Liquid Metals. Part V. Pb-Sn Alloys. L. L. Bircumshaw. *Phl. Mag.* 17. *pp.* 181–191, *Jan.*, 1934.—The surface tension of a number of lead-tin alloys across the whole composition range from pure lead to pure tin has been determined at a number of temperatures from just above the freezing-point to 800° C. The surface tension of all the alloys decreases with rise of temperature. Small quantities of lead produce a marked fall in the surface tension of tin, but relatively large quantities of tin have very little effect (slight rise) on the surface tension of lead. Assuming that the lead atom has the same dimensions as it has on the solid lattice, and using the method employed by Schofield and Rideal for determining the composition of the surface layer, it is shown that the latter, in the case of an alloy of eutectic composition, may consist of a unimolecular layer of lead atoms. It must be emphasised, however, that the deduction of this conclusion involves several assumptions. [For Part IV see Abstract 2 (1932).] AUTHOR.

497. Wetting Agents. H. A. Neville and C. A. Jeanson. *J. Phys. Chem.* 37. *pp.* 1001–1008, *Nov.*, 1933.—Sulphonates of the benzene series were found to produce a lowering of the surface tension of water increasing with the increase in length and complexity of the alkyl groups. The lowering of the surface tension is compared with that produced by other wetting agents. The adsorption of some commercial wetting agents by wool is appreciable only in acid solutions and it increases with increase in H-ion concentration. The wetting agents increase the take-up of basic dyes in acid solutions and decrease the take-up under other conditions. The results are interpreted in terms of the electrical condition of the fibre and the adsorption of the surface-active ions. P. H. B.

498. Dendrite Figures in Liquid Films. Part I. T. Tsutsui. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers. No.* 456. *pp.* 167–187, *Oct.*, 1933. *In English.*—A general investigation of the figures formed in thin liquid films produced by the separation of two glass plates between which the film is formed. Slow separation results in dendrite figures and more rapid separation produces cellular figures. The form of the dendrite figures is found to depend on the velocity of separation of the plates, the initial thickness of the film, the viscosity and surface tension of the liquid. When the velocity v of separation is slow the number of branches per unit area $= v/d(a+bv)$ where d is the initial thickness of the film and a and b are constants depending on the film material. The figures resemble those of flow lines in twisted metal rods. Numerous photographs are reproduced. P. H. B.

499. Mechanics of the Deformation of Films. A. V. Blom. *Kolloid Zeits.* 65. *pp.* 223–228, *Nov.*, 1933.—The present paper is limited to theoretical and experimental investigations of the effects of strain or stretching on the deformation of films. Translational effects due to Newtonian forces and rotational effects due to moments of rotation are not considered. Reference is made to the work of Hencky based on the law of Larmor-Jeffreys. Experimental work is carried out with films of pure nitro-cellulose, films containing one softener and films containing a mixture of softeners. It is shown that the addition of a resin to nitrocellulose has a different effect to that of adding softeners. The effect of both resins and softeners on nitrocellulose is also investigated. J. K.

500. Vaporous State of Myristic Acid Films on Aqueous Solutions. S. A. Moss and E. K. Rideal. *Chem. Soc., J. pp.* 1525–1528, *Nov.*, 1933.—A determination of the surface tension (γ) : surface concentration (A) relationship for vaporous films. A rectangular brass trough was divided into four roughly equal rectangles by a brass strip parallel to the longer side and a waxed copper wire float parallel to the shorter side. At the centre of the apparatus there was a gap in the brass strip and the wire float was bent to clear the liquid surface. The strip and the float together with suitably placed vaselined silk barriers isolated two diagonally opposite rectangles and allowed the remaining two rectangles to inter-communicate. The liquid surface in each rectangle was cleaned and then myristic acid was introduced in successive small quantities into the intercommunicating rectangles, causing a slight rotation of the float which was detected optically and counteracted by a torsion method. The experiments show that $\gamma A = 0{\cdot}5$ RT indicating that the molecules of myristic acid exist under the conditions of the experiment (about 800 to 15,000 Å^2 per molecule) in a stable associated state in the two dimensional vaporous phase, with two molecules of acid in each associated complex. P. H. B.

501. Capillary Rise of Hydrosols and of Solutions of Dyes. Influence of Concentration and of Electrolytes. A. Boutaric and M. Peyraud. *Comptes Rendus,* 197. *pp.* 1218–1220, *Nov.* 20, 1933.—For solutions of colloids and semi-colloidal dyes the rate of rise in the capillaries of, *e.g.*, filter paper, is independent of the concentration if the dispersed particles (or ions) are negatively charged, whereas if the particles are positively charged the rate increases in a linear manner with rise of concentration. This difference may be employed to determine the sign on the particles in a given dispersion, provided it is recognised that at low (0·1 gm. per litre) concentrations the rate of rise is always greater for negative than for positive particles. Addition of electrolytes retards the rate of rise of negatively charged particles, the effect increasing with increase of valency of the kation ; with positively charged particles acceleration or retardation may occur, and in some cases the rate of rise passes through a maximum as the concentration of electrolyte is increased. H. F. G.

502. Theory of Electrocapillarity. Part II. Thermodynamics. S. R. Craxford, O. Gatty and J. St. L. Philpott. *Phil. Mag.* 17. *pp.* 54–64, *Jan.*, 1934.—By using the discussion of capillarity published in a previous paper [see Abstract 5185 (1933)] expressions have been deduced for the temperature and pressure coefficients of surface tension. The former contains a term omitted by Gibbs, which would become significant for very small radii of curvature. These expressions have been extended so as to give an equation for the rate of change of surface tension with curvature of the surface. An expression due to Butler, which shows the difference in partial molal free energy of a substance when in the interphase and when in the bulk phases, is extended to a thick interphase by a method that illustrates in a novel way why the partial molal energy of a substance is the same throughout a whole phase. Finally, the Gibbs adsorption equation is re-deduced, and the exact conditions under which it is valid are discussed. AUTHORS.

See also Abstracts 732, 740.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstracts 473, 749.

VACUA, HIGH.

503. Vacuum-Leak Hunting with Carbon Dioxide. D. L. Webster. *Rev. Sci. Instruments*, 5. *pp.* 42–43, *Jan.*, 1934.—The advantages of carbon dioxide for detecting and locating leaks in vacuum apparatus are noted here, with descriptions of methods used, especially for very small leaks. AUTHOR.

VISCOSITY, FRICTION AND LUBRICATION.

504. Viscosity of Natural Gas. W. B. Berwald and T. W. Johnson. *Bureau of Mines. Techn. Paper, No.* 555. [34 *pp*.], 1933.—A simple form of viscometer for gases, calibrated by means of air flow is described. Values of the viscosities at 60° F and atmospheric pressure of 25 natural gases of widely different chemical composition, ranging from almost pure methane to a wet casing-head gas containing heavier hydrocarbons are tabulated. Over the range 40° F–80° F the viscosity of three representative gases, increases about 7 %. The viscosity at pressures up to 500 lb. per sq. inch pressure showed no consistent variation from that at atmospheric pressure. J. S. G. T.

505. Relation between Viscosity, Vapour Pressure and Density. F. Hovorka. *Am. Chem. Soc., J.* 55. *pp.* 4899–4900, *Dec.*, 1933.—The empirical equation $S = \eta P^{\frac{1}{4}} d^{\frac{1}{3}}$, in which η = viscosity, P = vapour pressure, d = density and S is a constant characteristic of the substance under consideration, is stated to be satisfied by a large number of organic liquids. A few examples are tabulated for a range of values of P. The value of S appears to vary systematically throughout such a series as the aliphatic esters or the saturated hydrocarbons and to approach a constant value characteristic of the series. R. W. P.

See also Abstracts 424, 468, 701, 712, 732.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT

See Abstract 635.

COMETS AND METEORS.

506. Method for Computing Orbits when Long Time Intervals are Available. M. Davidson. *Roy. Astron. Soc., M.N.* 94. *pp.* 76–85, *Nov.*, 1933—The method is for use with computing machines where a comet or minor planet has been observed over a considerable period. A preliminary orbit is required. The geometrical and dynamical conditions are fully given. The limited applicability of Gibbs' formulæ is discussed. Detailed examples of the application of the method to comets and to minor planets are given. T. L. M.

507. Capture of Comets by the Solar System. J. Chazy. *Comptes Rendus*, 197. *pp.* 1193–1194, *Nov.* 20, 1933.—The author extends Schwarzschild's proposition that comet capture cannot be permanent for a solar system simplified to the Sun and Jupiter, to a similar proposition for *n* bodies so long as their mutual distances exceed a certain length, and *n*-1 form a system of limited dimensions ; in such a case capture of the *n*th body would not be permanent. The question is raised whether the actual distances between the bodies allow of their treatment as material points.

T. L. M.

508. Problem of Meteorites : Tektites as Meteoric Bodies. F. E. Suess. *Naturwiss*, 21. *pp.* 857–861, *Dec.* 8, 1933.—The distribution, manner of occurrence, and shape of the tektites, australites, moldavites, and Darwin glass, and their generally similar composition and constitution, combined with the much greater similarity in these respects of each separate group *inter se*, and the essential difference from terrestrial glasses, all point to their meteoric origin. As regards the general origin of meteorites their composition and constitution point to their not coming from interstellar space, but to their originating in absence of water or oxygen, at a temperature ≯ 1500°, where further rapid cooling was possible, and where there was no strong gravitational field. The theory is suggested that they have passed through the following phases : (*a*) Astral, their materials are mixed at a high temperature on the surface of a sun-like body ; (*b*) apostactic, great drops of this material are thrown off ; (*c*) kathartic, the material of such drops separates into outer slag-like and inner metallic portions : (*d*) porotic, solidification sets in rapidly enough to form chondri and widmanstatten figures ; (*e*) diathraustic, the rapid cooling causes disruption ; (*f*) perihelic, the fragments circulate round the sun the heat of which when near thereto removes the more volatile elements ; until (*g*) atmospheric, they fall as meteorites through the earth's atmosphere.

C. A. S.

COSMOGONY.

509. World-Relations and the "Cosmical Constant." E. A. Milne. *Roy. Astron. Soc., M.N.* 94. *pp.* 3–14, *Nov.*, 1933.—In this paper the author further develops his kinematical model of the universe and deduces from it that the constant of gravitation, G, must be increasing at present at the rate of one part in two thousand million a year, provided the masses of " particles " are assumed to be constant. He also claims to be able to interpret the Einstein universe on his model and to show that the " cosmical constant " is not constant, but varies with the time.

G. C. McV.

See also Abstracts 520, 521.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

510. Distributions of Mass Producing the Same Potential in a Common Enclosed Region. P. Dive. *Comptes Rendus*, 197. *pp.* 1191–1193, *Nov.* 20, 1933.—In a previous discussion of potential in enclosed spaces [see Abstract 4098 (1931)] the author found that under certain conditions it was impossible for two bodies to produce the same potential over the same enclosed space, so long as the two bodies were simply connected. It is now shown that this is possible by considering the common region of the cavities of two intersecting homœoids, which are then made simply connected by removing a portion of their common ring.

T. L. M.

LATITUDE AND LONGITUDE.

See Abstract 565.

NEBULÆ.

511. Nuclei of Two Planetary Nebulæ. G. G. Cilliè. *Roy. Astron. Soc., M.N.* 94. *pp.* 48–59, *Nov.*, 1933.—Some plates of the spectra of the planetary nebulæ N.G.C. 6826 and N.G.C. 2392 were measured in order to test the possibility of their nucleii being white dwarfs. If the latter are dense stars of this kind, it is to be expected that there will be a gravitational shift to the red of the nuclear absorption lines as compared with the emission lines of the enveloping nebula. Applied to N.G.C. 6826, the method yields a red-shift which is expressed as a Doppler velocity of 54·3 km./sec. The spectrum is classified as O5 with a probable temperature of 30,000° K. These results lead to a radius of 0·305 $\odot$, a mass of 25·3 $\odot$ and a mean density of $1\cdot2\times10^3$ gm./c.c. The spectrum of N.G.C. 2392 is of type O7 with probable temperature of 26,000° K., but no evidence of a red-shift in the spectral lines was found. G. C. McV.

512. Red Cloud in Orion. K. Graff. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 7. *pp.* 279–284, 1933.—When observing bright nebulosities in Orion with a binocular in Majorca in Oct. 1932, a region was remarked which appeared to be veiled by a brown or reddish cloud. It has an average width of 7°, and extends from north to south of the constellation, passing east of the stars of the belt, and occupying altogether at least 250 square degrees. It is very irregular both in shape and brightness, and has clear indications of structure ; the edges are often very sharp, and within it are three well-defined gaps or islands of clear blue-black. It does not appear to have been recorded before, and cannot be photographed because of the presence of much bright nebulosity in the neighbourhood. When plotted on a map showing only B0 to B5 stars, the cloud appears as an almost starless void, except in the three islands where there are some stars. This is evidently an effect of absorption, and it is shown also by many B8 and B9 stars, and most of the A and A0, but with A2 and all later types there seems to be no connection at all. Stars with stationary calcium lines show a marked tendency to collect along the outside edge of the cloud and in the island which contains λ Orionis. Assuming from the foregoing data that the cloud begins beyond the distance of A stars, which have a mean magnitude of 9^{m}, and therefore an absolute magnitude of $+1^{m}.0$, its parallax will be $0''.0025 = 1300$ light-years. M. A. E.

513. Contours of Emission Lines in Expanding Nebular Envelopes. B. P. Gerasimovič. *Zeits. f. Astrophysik*, 7. *pp.* 335–349, *Dec.* 23, 1933. *In English.*—This paper deals with the contours of emission lines produced by expanding nebular envelopes surrounding Novae, Wolf Rayet and P Cygni stars. It is shown that sloping sides in these contours cannot be accounted for by the internal spread in velocities of thermal or turbulent character. Such contours can be explained supposing the variation in velocities inside the envelope as produced by the radiation-gravitation field of the central star. The method for deriving the law of acceleration from spectrophotometric data is proposed and applied to Nova Aquilae 1918. It is shown that at a certain stage of the Nova carrier the envelope was moved with decreasing velocity. The method for deriving the number of atoms per cm^{2}. of stellar surface, which are capable of producing a given line, is developed and applied to Nova 1918 and P Cygni. The effect of self-absorption is finally discussed. AUTHOR.

514. Linear Diameters of 125 Large Galaxies. H. Shapley. *Nat. Acad. Sci., Proc.* 19. *pp.* 1001–1006, *Dec.*, 1933.—The angular diameters of the five largest galaxies in each of 25 groups are tabulated and averaged. This mean is found to be a fair criterion of distance. The mean linear diameter is provisionally taken as 4·2 kiloparsecs. The distances are revised on this basis and new values derived for the mean density of matter in space. A study of 2650 members of the 25 groups shows no object larger than the Andromeda nebula. The large Magellanic Cloud is comparable with the mean of the 125 largest; the small Cloud is of average size; nothing at all comparable with our galactic system is found. T. L. M.

See also Abstract 534.

PLANETS.

515. Photometry of Saturn and his Rings. N. Barabascheff and B. Semejkin. *Zeits. f. Astrophysik*, 7. *pp.* 290–302, *Nov.* 12, 1933.—Photographs taken with red, yellow and blue filters show differences in distribution of light intensity. The diminution in brightness from centre to limb of Saturn is least for the blue radiation, and is much more rapid towards the poles than towards east and west. The outer ring shows almost equal intensity in all colours, but the middle ring is much brightest in blue. The space between the crape ring and the planet is practically dark in red and yellow, but has a remarkable intensity in blue, which seems to prove that this ring extends as far as the planet, in a very tenuous state, and scatters light of short wave-length. M. A. E.

516. Rotation Period of Equatorial Zone of Saturn. J. P. Rowland. *Roy. Astron. Soc., M.N.* 94. *pp.* 86–91, *Nov.*, 1933.—The white spot discovered on Aug. 3, 1933, was observed at Stonyhurst with the filar micrometer; the method of making settings in view of the difficulty of the observation is fully described. Resulting rotation periods are tabulated, the best observations giving 10h. 14m.1 consistently. Residuals are tabulated from all observations traced, Aug. 3–Sept. 16, showing considerable evidence of varying rates; this is discussed in terms of increasing altitude of the disturbance. Observations which may refer to at least two other spots are discussed. T. L. M.

517. Families of Asteroids. K. Hirayama. *Imp. Acad. Tokyo, Proc.* 9. *pp.* 482–485, *Nov.*, 1933. *In English.*—Five families have been under observation since 1918, and for each of these the number of members, their elements, and the mean deviations are given. New members are frequently discovered, and the smallest family (Maria) is now known to contain 16, the largest (Flora) 81. The hypothesis of a resisting medium acting on these small bodies is negatived by the observations. M. A. E.

518. Ray System of the Lunar Crater Tycho. K. Graff. *Akad. Wiss. Wien, Ber.* 142. 2a. 7. *pp.* 309–311, 1933.—As a contribution to the theories respecting the origin of lunar rays, the system of Tycho has been mapped on an orthographical projection with this crater as the pole, and many rays are shown to diverge therefrom and to follow tracks very nearly coinciding with great circles. This confirms the theory that they arose as cracks on the moon's surface, probably due to internal pressure, and is entirely against the theory of aerial origin. M. A. E.

519. Reference Chart for Apparent Motions of Sun, Moon and Planets. B. K. Vaidye. *Nature*, 133. *p.* 33, *Jan.* 6, 1934.—The chart is a plot of right ascension against day of year. Declination is not included. Devices for the inclusion of all appropriate phenomena are explained and illustrated. T. L. M.

520. Quantity of Ozone in Planetary Atmospheres. D. Eropkin. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R., Leningrad, No.* 5. *pp.* 64–69, 1933. *In French.*—The author discusses the effect of distance from the sun on the amount of ozone in the upper atmospheres of planets; the increase in ozone with latitude on the earth is used to determine the rate of increase for more distant planets. A comparison of the faint ozone bands in the visible spectrum with the spectra of planets suggests a number of coincidences especially for Uranus and Neptune. The general oxygen reaction is briefly considered. The author does not support the view of a different chemical constitution of the atmospheres of the earth and the great planets. T. L. M.

521. Terrestrial Abundance of Permanent Gases. H. N. Russell and D. H. Menzel. *Nat. Acad. Sci., Proc.* 19. *pp.* 997–1001, *Dec.*, 1933.—The problem is the relative scarcity of N and Ne on the earth as compared with stars and nebulæ. The possibility of their rarity in the sun itself is discussed and dismissed. The classical escape theory is shown to give negligible loss for gases other than H. Collision with an excited oxygen atom (auroral spectrum) could impart escape velocity to He. The escape of N and Ne requires a high surface temperature, such as could not have prevailed for a long period. The authors conclude that these elements were lost during the initial formation of the earth, which cooled sufficiently rapidly to prevent complete loss. T. L. M.

522. Planetary Photography. V. M. Slipher. *Nature*, 133. *pp.* 10–13, *Jan.* 6, 1934. *Royal Inst., Proc.* 27. 5. *pp.* 903–921, 1933.—A review of planetary observations, visual, photographic and spectral, at the Lowell Observatory since 1894. They include: Mercury, confirming that the planet is without atmosphere and keeps a constant face to the sun. Venus is assumed also to keep a constant face to the sun since the spectroscope has failed to reveal any rotation shorter than several weeks; its atmosphere is not earth-like and has no bands of oxygen or water. Mars; the waxing and waning of its polar caps harmonise with its calendar, indicating an atmosphere and its spectrum gives both oxygen and water; its temperature is about 48° F.; there is a reality underlying its canal phenomena, but there is difference of opinion about its interpretation. In the major planets (Jupiter to Neptune) ammonia and (possibly) methane gas have been identified, but are weakened progressively from Jupiter outwards with distance from the sun; on the other hand, absorption bands increase in intensity from Jupiter with the greater distance. The atmospheres of these four outer planets are more effective than the atmospheres of the earth-like group in utilising their " small energy gift from the sun," by conserving the energy of the longer heat waves. Photographs are reproduced of the planets, Mars, Jupiter and Saturn, and comparison spectra of the moon and four outer planets. A. S. D. M.

523. Planetary Photometry. N. Barabascheff and B. Semejkin. *Zeits. f. Astrophysik,* 7. *pp.* 303–308, *Nov.* 12, 1933.—Experiments with a white metal globe, both polished and unpolished, show that the laws of reflection for planetary surfaces cannot be deduced from observation of artificial globes, because the slightest variation in surface structure causes considerable change in the brightness distribution. Material is now being collected for a direct photometric study of the planet Mercury. M. A. E.

See also Abstract 506.

STARS.

524. Constants of Motion of G, K and M Stars. Renée Canavaggia and Marie-Louise Fribourg. *Comptes Rendus,* 197. *pp.* 1194–1195, *Nov.* 20, 1933.—The motion of the stars in the galactic plane is treated as given by linear functions of the rectangular co-ordinates. The six coefficients are tabulated for 1524 stars, in type groups and in the mass. The Strömberg asymmetric current is clearly indicated. T. L. M.

525. Spectroscopic Observations of the Variable Star RS Ophiuchi. A. Colacevich. *Accad. Lincei, Atti.* 18. 7–8. *pp.* 307–310, *Oct.*, 1933.—This star was first discovered to be variable by (Mrs.) Fleming in 1901, but Harvard plates taken earlier proved that from 1888 onwards it had oscillated slightly round $10^{m}\cdot5$, and that in 1898 it had suddenly risen in one month to $7^{m}\cdot7$, dropped again in three months to its usual magnitude, and varied irregularly afterwards. Spectrograms showed emission lines in H, ionised Fe, and others. C. E. Pickering called it a Nova, but it is not typical of that class. In 1933 there was another short-lived brilliant maximum, the star rising suddenly to $4^{m}\cdot3$ on August 12. Five spectrograms were secured at Arcetri, August 24 to 27, when the star was varying between 6th and 8th magnitude. They consist of bright lines only: if any continuous spectrum exists it is very feeble and indicates a magnitude of less than the 10th. Of the 40 bright lines tabulated, the brightest are due to H and He, others to ionised Fe, N, Si, Ti, and 5 are nebular lines. Further research is necessary to discover whether, in this and similar stars, the spectrum varies at successive outbursts, and how they are related to the typical Novæ. M. A. E.

526. Spectrum of Nova RR Pictoris (1925), 1933. H. S. Jones. *Roy. Astron. Soc., M.N.* 94. *pp.* 35–39, *Nov.,* 1933.—An account is given of two negatives of the spectrum of this star obtained in 1933, with a view to determining the changes which have occurred during the year. These are slight. The continuous spectrum has become stronger, the line He^+, λ4686, has become the brightest in the spectrum, the relative intensities of the two strong unknown lines λ5723 and λ6088 have changed and there appears to be a slight decrease in the Balmer decrement. The magnitude of the star continues to decrease at a very slow rate. G. C. McV.

527. Study of Effective Wave-Lengths with the Recording Microphotometer. Alice H. Farnsworth. *Lick. Obs., Bull. No.* 456. *pp.* 145–156, 1933.—A check on the usual method of determining star colour (from the photographic-visual stellar magnitudes) by the application of the Moll microphotometer to the selection of the " effective " wave-lengths on plates taken in the Lick Crossley reflector. It is found that the thermo-couple picks out a point of spectral maximum intensity, definitely ; the redward slope of the spectral arch is steeper than the blue ; and the amount by which the central peak falls below the opaque line is an inverse measure of the central image intensity. The Moll instrument has a large periodic error in the worm-gear, connecting plate and recorder, a difficulty overcome by working always at the same phase of the periodic curve, but which is altogether avoided by an instrument not using a screw-thread (such as the Zeiss photoelectric recording photometer). The thermocouple, unlike the eye at the microscope, fails to show any sensible effect of image intensity on spectral distances. Plate errors have been corrected but not those due to absorption. No great divergence between the eye and thermocouple estimates is found for effective wave-lengths, and there is little gain in precision by the use of the microphotometer. A linear relationship between spectral distance and colour-index (Yerkes Actinometry System) is established for 26 standard stars with some supporting data from the North Polar Sequence. [See following Abstract.] A. S. D. M.

528. Colour Changes in Variable Stars. Alice H. Farnsworth. *Lick Obs., Bull. No.* 156. *pp.* 157–158, 1933.—Nine objective-grating plates of δ Cephei were taken by the Lick Crossley reflector to detect change in colour with period, since this star becomes redder at minimum ; its 7th magnitude companion, 41″ distant, makes a convenient standard star for comparison. A curve confirms the reddening at minimum, and the descending branch shows fluctuations which may prove to be real. Grating plates were taken repeatedly on single nights of 17 other variables (mostly cluster-type Cepheids) during the predicted time of rise ; about half of these show some reddening towards minimum, and more show the expected change in intensity, but in 3 cases only are the two changes concomitant in the same star. But in all these instances there is no such convenient comparison star as with δ Cephei. Even in a single night, the changes in brightness and colour are so great that only a differential method of reduction for the variable is trustworthy. Curves are given for RR Leonis. More intensive study is needed of all phases for a small number of variables to test suspected changes during the rise to maximum. [See preceding Abstract]. A. S. D. M.

529. Influence of Colour on Photoelectric Measures of Stellar Brightness. M. Maggini. *Accad. Lincei, Atti*, 18. 5–6. *pp.* 223–226, *Sept.*, 1933.—It is well known that the photoelectric photometers used for observing variable stars vary in sensibility to different wave-lengths. Therefore unless the radiation is monochromatic it must be uncertain whether the results obtained are chiefly due to variation in colour or in magnitude. By comparing results obtained when using cells of sodium and of rubidium in conjunction with different colour filters, it is shown that variations in colour may sometimes completely mask variations in magnitude. It is further possible that some stars vary, not in magnitude but in colour only, and this opens up a new field in photometric research. M. A. E.

530. Relation Between Colour Index and Spectral Type. W. Becker. *Zeits. f. Astrophysik*, 7. *pp.* 281–289, *Nov.* 12, 1933.—In estimating temperature from colour index, it should be realised that slight differences in colour exist among the sub-types in different classes, owing to selective interstellar absorption in B stars, hydrogen absorption in A and F, line and band absorption in G, K and M stars. M. A. E.

531. Star Colours and Galactic Latitude. K. Graff. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 7. *pp.* 285–288, 1933.—With a new type of colorimeter [see Abstract 774 (1932)] an investigation of star colours has been made, and these have been compared with spectral types and sub-types. It is found that the differences, colour – spectrum, are directly related with galactic latitude, stars of similar spectral classes appearing whiter near the galactic pole than those in its plane. Six years ago E. S. King found that colour excess increases with stellar distance for stars having a parallax greater than 0″·030, and he deduced therefrom the existence of an absorbing cosmic cloud between us and the stars in our near neighbourhood. Our results confirm this hypothesis. M. A. E.

532. Stability of Atkinson's Star Models. G. Steensholt. *Zeits. f. Astrophysik*, 7. *pp.* 373–376, *Dec.* 23, 1933.—The stability coefficient of the Atkinson models previously studied by the author [see Abstract 127 (1933)] is calculated as though the amplitude of oscillation were proportional to the radius vector. On this and certain other plausible assumptions, the models are shown to be unstable. AUTHOR.

533. Reflection Effect in Eclipsing Binaries. W. Krat. *Roy. Astron. Soc., M.N.* 94. *pp.* 70–76, *Nov.*, 1933.—The author starts from Milne's formula for the variation of intensity of re-radiated light from the secondary; and derives an expression for the ratio of reflected light to ordinary light over the disc. A detailed comparison with observation shows good agreement where the colour difference between primary and secondary is small; where this difference is large the computed effect is much greater than the observed. The increase of reflection near periastron does not account for the observed periastron effect, which the author regards as due to tidal pulsation. T. L. M.

534. Summary of Variable Star Survey in External Galaxy. H. Shapley and J. Mohr. *Nat. Acad. Sci., Proc.* 19. *pp.* 995–996, *Dec.*, 1933.—An investigation of the periods and light curves of 1346 variables in the Large Magellanic Cloud; these are scattered throughout its area and thereby give some idea of the incidence of Cepheid variability among supergiant stars, within given intervals of luminosity; Cepheids form 1½ % of all supergiants between absolute magnitudes – 1 and – 4 over all regions; but on the axis of concentration they form 4 %, and in the sparse districts, only one star in 200. The most numerous periods are those of 2 to 3 days and there is no discontinuity in the luminosity curve for longer periods. No important correlation exists between amplitude of variation and luminosity or period. There is evidence of light absorption by nebulosity within the Cloud. Long exposure photographs have given for the Cloud a diameter of about 7°, but new evidence, from star counts and affiliated clusters, indicates one of 12° and a linear diameter of not less than 15,000 light years. A. S. D. M.

535. Possibility of Photometric Measurement of Extra-Focal Photographs with Mirror Telescopes. V. Oberguggenberger. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 3–4. *pp*. 103–108, 1933—Prey has shown that it is theoretically possible to determine the positions of stars from measurements of extra-focal photographs taken with a reflecting telescope. The large reflecting telescope at Innsbruck (aperture 1 : 2·5) could be used for measurements of the positions of very faint stars were it not for the fact that the times of exposure become so long that the extra-focal ring systems become blurred. A practical method of measuring the extra-focal photographs is evolved which consists essentially in placing a ground-glass screen in front of the plate in order to even out the extra-focal ringed image into a symmetrically blackened image which is suited to photometric measurement. J. E. K.

See also Abstracts 511, 513.

SUN.

536. Solar Chromosphere. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 94. *pp*. 14–35, *Nov.*, 1933.—Milne's theory of the chromosphere based on monochromatic radiative equilibrium is further developed in order to deal satisfactorily with such questions as the march of the density distribution and the hydrogen chromosphere. The " turbulence " ideas of M'Crea and Menzel are adversely criticised and the new development is based on the assumption that the solar surface does not radiate uniformly everywhere whilst the support of the chromosphere is still by monochromatic radiation. The special case of variation of the intensity of emergent radiation over the surface according to a simple harmonic law is worked out in detail and leads to the order of kinetic velocities for the atoms which observations indicate and which were not obtainable from the theory in its original form. The theory also accounts for prominences and gives a satisfactory march for the density distribution. G. C. McV.

537. Magnetic Field of Sunspots. T. G. Cowling. *Roy. Astron. Soc., M.N.* 94. *pp*. 39–48, *Nov.*, 1933.—The theory proposed by Larmor, that the magnetic field of a sunspot is maintained by the currents it induces in moving matter, is examined and found to be faulty. The possibility is investigated that the sunspot field may arise as a disturbance in the (almost horizontal) general field of the sun. Several properties of the magnetic field of the spot are explicable in this way but observations are not yet sufficiently complete to test the hypothesis accurately. G. C. McV.

538. Sulphur Spark Lines in the Solar Spectrum. O. Bartelt and L. Eckstein. *Zeits. f. Astrophysik*, 7. *pp*. 272–280, *Nov.* 12, 1933.—The coincidence of a large number of multiplets of the S II spectrum with lines of the solar spectrum is shown. D. H. F.

See also Abstracts 519, 597, 618, 635.

GEOPHYSICS.

GEODESY.

539. Tilting Due to Glacial Melting. B. Gutenberg. *J. of Geology,* 41. *pp.* 449–467, *July–Aug.,* 1933.—To investigate tilting and changes in level in the United States and Canada, results from the records of tide gauges of different stations were analysed. In the Great Lakes region all results indicate a tilting of the land upward in a northerly direction, by about 10 cm. per 100 km. per century. Along the Pacific coast a small rising of the land is indicated at the north, whereas in California the changes in height seem to be negative, but small and irregular. Along the Atlantic coast of Canada the changes are small and within the limits of error nearly everywhere, but south of Portland (Me.) sinking prevails clearly. It is very probable that the tilt in the Great Lakes region is due to forces which tend to restore isostatic equilibrium, disturbed by the melting of ice after the Ice Age. AUTHOR.

540. Departures from the Geoid Based on the Formula of Stokes. R. Schumann. *Gerlands Beitr. z. Geophys.* 40. 2–3. *pp.* 298–304, 1933.—Calculations are made, based on Stokes' formula, of the effect of loading the surface of the earth with a cap. The results are considered with reference to the theory of isostasy. W. A. R.

See also Abstract 565.

GEOPHYSICS, APPLIED.

541. Measurement of Magnetic Field Distortion. A. O. Rankine. *Phys. Soc., Proc.* 46. *pp.* 1–15, *Jan.* 1, 1934.—Magnetometers of the portable, field type used in geophysical prospecting for measuring the local distortion of the earth's magnetic field due to magnetised buried masses depend for their sensitivity on the compensation of the regional field by means of torsion wires, currents, balance weights and similar devices. In the analogous gravitational field, the Eötvös torsion balance presents an arrangement which is in effect self-compensating, and which is only sensitive to local spatial variations in the general field of gravity. In particular, such an arrangement is insensitive to those temporal variations of the main field which, in the magnetic case, cause much trouble in practice. The possibility of realising a magnetic torsion balance, precisely analogous to the Eötvös gravity balance, is here considered as a method of eliminating temporal variations of the main magnetic field. It is shown that, whereas extreme sensitivity of measurement of local spatial variations of the magnetic field is theoretically possible with such an arrangement, the practical construction is rendered very difficult on account of the horizontal component of the main field; this exerts a preponderating torque on the suspension fibre so long as any minute inequality of matching persists, as regards pole strength and axial direction, in the two magnets which are needed to provide the suspended system with equal, like poles at its extremities. Whereas the difficulty of matching these magnets with sufficient precision appears to preclude the possibility of constructing a portable magnetic balance of this type, it is shown that the principle can be applied to construct an extremely sensitive laboratory balance for the measurement of weak magnetic susceptibilities, and work on these lines is proceeding. E. L. J.

HYDROSPHERE, PHYSICS OF THE.

542. High-Tide Gauges. A. Beer. *Naturwiss.* 21. *pp.* 890–894, *Dec.* 22, 1933.—The author refers first to the methods of harmonic analysis employed to determine the periods of tidal components and from a knowledge of the local amplitude and phase, the times of high and low water are found and published in tide tables. A brief description is given of a German form of tide calculating machine. A description is also given and diagrams illustrate the construction and action of a form of tide measurer for use in the open sea. By photographic means the rise and fall of the water level is recorded. R. S. R.

543. Motion of Lake Water Generated by Winds. Part I. K. Hidaka. *Geophys. Mag., Tokyo.* 7. *pp.* 233–244, *Nov.*, 1933. *In English.*—The author seeks to find the motion of water caused by a disturbance on the surface of a lake and to apply it to the problem of seiches generated by the tangential stress of winds on the lake surface. In this paper Stokes' method is applied and integral equations of the Volterra type obtained for the cases of large and small viscosity. These equations, although elaborate, can be solved by constructing the reciprocal functions or by the method of iteration. This problem is treated as two-dimensional, but it can be extended without difficulty to three-dimensional provided the earth's rotation is neglected. R. S. R.

544. Tidal Bores which Assume the Form of a Group of Short Waves. V. Cornish. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 3. *pp.* 183–190, *Jan.*, 1934.—The author supplies details regarding observations made on the tidal bores of the Severn and Trent. The former has been observed as a steep wave curling over into a scroll in shallow water but changing to a group of rounded swells in deeper water. The latter has been seen as a long train of steep rounded waves, in places even 4–5 ft. high, having on the average a wave length of 25 ft., a maximum slope of 9° and up to 100 waves in the train. The average speed was on one occasion 8·6 m.p.h. and the period 2 sec. Near Gainsborough the bore was followed on some occasions for several miles and successive observations made. A second bore, sometimes seen, has a smaller amplitude, the same wave length, and the same number of waves in the group. The cause is suggested to be sandbanks in the Humber estuary. R. S. R.

See also Abstract 539.

LAND, PHYSICS OF THE.

See also Abstracts 541, 573, 627.

METEOROLOGY.

545. Origin of Atmospheric Ozone. Researches at Scoresby Sound during the Polar Year. A. Dauvillier. *Comptes Rendus,* 197. *pp.* 1339–1341, *Nov.* 27, 1933.—Observations on the ozone content near the ground were made from mid November, 1932, to mid August, 1933. A chemical method was used to estimate the amount present. As a result a curve is obtained showing a maximum towards the end of December. This high value would continue in the polar night but for the effect of the wind. The high winds of January bring the observed content down, but in February, which was calm, the content rises again at first, then falls towards the end of the month as the altitude of the sun increases. Thus the curve points to the auroral activity as the source of the oxone, and to solar radiation as its destroyer. After the middle of March the variation in content is comparatively small. Also no relation is found between ozone content and barometric distribution, nor does it play any part in the formation of depressions. A check on the ozone content has been made by examining the ultro-violet spectra of the sky taken during the winter, and those of a mercury lamp at 600 m. during the spring. A. E. M. G.

546. Temperature of the Air near the Ground. C. E. Brazier and L. Éblé. *Comptes Rendus,* 197. *pp.* 1678–1680, *Dec.* 13, 1933.—The sources of error to which the readings of a thermometer placed unprotected near the ground, are liable, are enumerated. To overcone these, an aspiration method, the details of which are described, is employed to find the true temperature of the air near the ground. For purposes of comparison a table has been compiled from readings obtained over a period of two months by both methods. The values of the mean maxima and mean minima as determined by the two methods, differ, the maxima by about 7° C., the minima by about 1° C. and in the opposite sense. A. E. M. G.

547. Seasonal Weather and its Prediction. G. T. Walker. *Nature,* 132. *pp.* 805–808, *Nov.* 25, 1933. *Presidential Address to the British Assoc., Leicester, Sept.,* 1933.—The reasons for a fuller investigation and a more successful prediction of seasonal weather, particularly in connection with some areas, are first considered. The method of correlation is a suitable method for attacking such a problem. The analysis of data (pressure and temperature) for the North Atlantic area and Western Europe over the winter period enables a curve to be drawn or a set of numbers compiled, expressing the variations of the North Atlantic fluctuations as a whole. The correlation coefficients of such a curve or set of numbers with the contemporary pressure temperature and rainfalls of particular places may then be found. Charts are drawn with these coefficients for the different elements, plotted on them. The same method is applied to the North Pacific area and to the southern oscillation. Charts for the latter area are reproduced showing the relationships of pressure, temperature and rainfall of December to February with the numbers indicating the fluctuation of the previous June to August. The investigation shows that a real control of 0·7 by previous conditions is about as good as is now available for forecasting and so predictions can only be issued with restraint. The author now turns to consider what has already been attempted in seasonal prediction in tropical, subtropical and temperature regions. He points out that in India some of the forecasts first attempted were done on too small data. Later work, carried out with a fuller knowledge, has been more successful. The paper concludes with a consideration of improvements in the method, and a search for the physical cause of the seasonal fluctuations. Various probable causes, such as increase of solar activity, suggest themselves, but up to the present these have led to no definite conclusions. The whole problem still awaits solution. A. E. M. G.

548. Effect of Topography on the Direction and Velocity of Winds. H. Arakawa and N. Murase. *Geophys. Mag., Tokyo,* 7. *pp.* 225–231, *Nov.,* 1933. *In English.*—The assumptions made in the investigation are that (1) the flow is steady, continuous and free from eddies, (2) the effects of viscosity and surface friction can be neglected, (3) at great heights the wind current is purely horizontal and of constant velocity, and (4) the surface profile is periodic or that the earth's surface is formed of similar parallel waves of mountains. The same principles are used as in an earlier paper [see Abstract 3437 (1933)]. Tables illustrate the wind velocities and directions at various heights. It is found that (1) the maximum velocity occurs at the summit and the minimum at the bottom of the valley, and (2) at the summit the component of wind transverse to the ridge is a maximum and the wind parallel to the ridge a minimum, while the reverse holds at the bottom. Many examples in Okada's *Climate of Japan* illustrate the results. R. S. R.

549. Envelopes of Isobars. G. Dedebant. *Comptes Rendus*, **197.** *pp.* **1447–1449**, *Dec.* **4, 1933.**—This is a continuation of previous work by the author [see Abstract 3440 (1933)]. The characteristic points of an isobar are first found. These points are the points of intersection of the isobar with the line of no tendency, the equation of the latter being the first derivative with respect to time of the equation of the isobar. Thereafter the velocity of a characteristic point with reference to the trajectory of the centre is considered, and the behaviour of the system examined from this point of view. The case when the no-tendency line does not cut the isobars is also dealt with. The author concludes the note by pointing out the difference between the barometric development previously discussed and that where the development can be judged by a study of the convergence and the divergence of the envelopes. A. E. M. G.

550. Atmospheric Turbulence. S. de Backer. *Comptes Rendus*, 197. *pp.* 1587–1589, *Dec.* 13, 1933.—A mathematical treatment of the equations defining the motion of a mass of air in turbulent flow. The result obtained is purely formal. J. W. T. W.

551. Shear Patterns in an Unstable Layer of Air. A. Graham. *Roy. Soc., Phil. Trans.* 232. *pp.* 285–296, *Nov.* 13, 1933.—A series of experiments is described in which a thin layer of air is subjected to shear when a temperature gradient exists across it. The patterns formed by the air motion are exhibited by smoke and photographed. It is proved that with an unstable air layer subjected to a single shear (1) longitudinal and transverse rolls may be obtained as with a double shear; (2) a square pattern may be obtained with its lines inclined at 45° to the shear; (3) between the polygonal and square patterns there is a transitional pattern, and (4) with a certain orientation the polygonal pattern is stable under the influence of a single shear having a suitable value. In a layer of air not subjected to shear (5) instability in the form of polygons does not occur suddenly, but the number of centres of motion increases steadily; the nature of the bounding surfaces makes no difference, qualitatively, to the effects, and (6) ascending columns may be produced in air by heating the lower surface and descending columns in water by cooling the upper surface. An explanation of the facts is supplied. The work shows that the longitudinal and transverse rolls of a cloud sheet can be produced by a single shear, and a new pattern in the form of a diagonal arrangement of squares has been found. The experiments suggest that normal and reticular cloud types are produced by heating from below and cooling from above respectively. In plates the various patterns obtained are illustrated and also some similar cloud forms. [See also Abstract 1880 (1932).] R. S. R.

552. Kinematography of Internal Movements of Cloud Masses. P. Idrac. *Comptes Rendus*, 197. *pp.* 1341–1342, *Nov.* 27, 1933.—This method enables the eye to follow with greater ease the developments within a cloud. The formation and the behaviour of a cumulus formed between two layers of air moving with different velocities and likewise the behaviour of the prominences in thermal cumuli are rendered much more clear than by direct observation. The author also refers to some observations made earlier by Devaux at the Pic-du-Midi, a similar method having been employed. Devaux found that in the holes between the rolls of strato-cumulus descending currents exist. To study further the formation of various cloud types it is proposed to film the clouds both from above and from below. A. E. M. G.

553. Distribution of Precipitation with Regard to its Daily Period. M. Kofler. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 1–2. *pp.* 19–24, 1933.—The author has tabulated for the four seasons and for the year mean values, for each hour at Vienna, of the duration, amount, intensity and probability of precipitation. These are based on observations Nov.–Mar., 1908–30, and Apr.–Oct., 1886–1930. He finds (1) a diurnal wave with two maxima in all seasons, this being most marked in the transitional seasons; (2) a reversal of the morning maximum in winter to an evening maximum in summer; (3) for the year the evening maximum occurs at 19–21 hours, with in summer a secondary maximum at 16–17 hours; the latter is apparent, also in winter and spring; (4) the morning maximum for the year occurs at 6–7 hours, but about 3 hours later in winter; the secondary maximum is less marked in autumn; and (5) diurnal amounts of precipitation are associated with the frequency, the season of rising temperature having a decreasing frequency but increasing intensity. The effects of diurnal pressure and temperature changes on these relations are discussed and it is concluded that (1) real convectional precipitation occurs at the time of progressive heating with increase of temperature and especially in the warm season, (2) precipitation due to cooling occurs at the time of progressive temperature decrease and especially in the cold season, and (3) dynamical precipitation occurs with ascending air movement with a semi-diurnal period corresponding to the pressure increase at all seasons. [See following Abstract.] R. S. R.

554. Diurnal Pressure Change. M. Kofler. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 7. *pp.* 329–338, 1933.—The author refers to the association of the diurnal pressure increase with the morning and evening maxima of precipitation at Vienna [see preceding Abstract], and to Hann's view regarding the existence of an 8-hour component and a semi-diurnal component in the pressure wave. The latter was ascribed to a resonance oscillation of the atmosphere due to the semi-diurnal temperature change. The author controverts Hann's view and seeks to associate the changes with physical processes in the atmosphere of a thermodynamic character. The 8-hour oscillation is found to have its maximum amplitude in summer and winter, but with opposite phases. With the sun at the equator the semi-diurnal oscillation is most regular and the 8-hour oscillation irregular while at the solstices the semi-diurnal oscillation is a minimum and the 8-hour oscillation a maximum, and the sign of the latter alters with the temperature of the seasons. Two superimposed waves are then taken and it is shown how the diurnal pressure wave may be obtained. One wave is due to heating of the lower atmospheric layers and the other due to cooling of the upper layers. This process explains (1) the intensification of the first wave and the weakening of the second on bright days, (2) the asymmetry of the complex pressure changes, (3) the decrease of the first wave with height, (4) the decrease and subsequent increase with height of the amplitude of the pressure oscillation, and (5) the retardation of the first, and acceleration of the second, pressure wave with height. The air movements causing these changes are explained. The change of wave-length and amplitude of the waves with the season, and the changes of water vapour content are summarised. The latter helps to explain the changes over the oceans and the maximum effect obtained in the sub-tropical anticyclonic girdle. R. S. R.

555. Absorption of Ultra-Violet Radiation in the Lower Atmosphere. L. Herman. *Comptes Rendus*, 197. *pp.* 1342–1344, *Nov.* 27. 1933.—According to previous measurements [see Abstract 2189 (1931)] continuous absorption below 2800 Å is found in the lower atmosphere. This has been attributed to oxygen. Other observations made with pure oxygen show a series of absorption bands. An endeavour to find this selective absorption was carried out at the Observatory at Lyons. The method adopted for this purpose is indicated in the paper. A system of ten bands occurs between 2800 and 2400 Å, the two of longest wave-length being very feeble. Each band appears triple. The possible significance of this phenomenon in aiding in the interpretation of previously observed absorption phenomena with oxygen at different pressures is considered. A. E. M. G.

556. Psychrometric Charts. D. B. Brooks. *Bureau of Standards, Misc. Publ. No.* 143 [3 *pp.*], 1933.—Charts have been developed for the Centigrade and Fahrenheit scales to determine the pressure of water vapour and relative humidity of the atmosphere from psychrometric observations. They are based on Ferrel's psychrometric formula: $e=e'-0\cdot000367\,P\,(t-t')\left(1+\frac{t-32}{1571}\right)$ where e and e' are the saturation pressure of water vapour and t and t' the Fahrenheit temperatures of dry- and wet-bulb thermometers respectively and P is the barometric pressure in inches of mercury. The charts halve the required time and are more accurate than the customary double interpolation tables. R. S. R.

See also Abstracts 463, 520, 521, 543, 568, 578, 730.

SEISMOLOGY.

557. Propagation of Seismic Waves. Part II. Amplitude of Seismic Waves with the Structure of the Earth's Crust and Mechanism of their Origin. H. Kawasumi. *Tokyo Univ. Earthquake Research Inst., Bull.* 11. *pp.* 403–453, *Sept.*, 1933. *In English.*—A general quantitative study of seismic waves is made, taking the actual structure of the earth into consideration. After a summary of previous investigations the case is first considered of spherical waves propagated in an isotropic elastic medium, then the effects of non-homogeneity, imperfect elasticity, and solid viscosity of the earth, the last being deemed negligible. The results are illustrated by application to the Central Japan earthquake of June 2nd, 1931, and calculated and observed results compared. [For Part I see Abstract 2768 (1932).] C. A. S.

558. Tectonic and Magmatic Earthquakes. H. Landsberg. *Naturwiss.* 21. *pp.* 894–896, *Dec.* 22, 1933.—The author distinguishes epirogenetic and orogenetic movements in the earth's crust the former being isostatic and causing fracture of the old layers and the latter fracture in young mobile zones. Various European zones where the former occur are quoted. The effects of intrusions and crystallisation in the upper zones in causing earthquakes are discussed. Diagrams are used to illustrate the decreased frequency of earthquakes with increasing depth in the subcrustal zone (100–700 km.) for the earth as a whole but the change does not occur in all areas and the differences are not due to chance distribution. This is explained by strata being at different depths, or by subcrustal flow due to radioactive changes and consequent temperature changes, or by crystallisation. It is concluded that in the subcrustal zone there are orogenic districts with mass stratification. These lead to overturning in magmatic material whereby sudden changes of position occur with earthquake phenomena. These processes produce reactions in the crustal zone which occur as phenomena of tectonic earthquakes and volcanic outbreaks and perhaps by intrusions not shown directly. R. S. R.

559. Upward Curvature in Seismic Time-Curves. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 201–202, *Jan.,* 1934. Most time curves in seismology are concave downwards this being the result of the epicentral distance (Δ) increasing with the angle of emergence (e). For some phases the reverse occurs. It is true notably for P_2' the upper branch of the curve for compressional waves through the core. It also occurs for any continuous increase of velocity with depth sufficiently strong to make the pulse triple over a range of distance. In the range between the points of maximum and minimum distance Δ decreases as e increases. If a rise or fall of velocity is discontinuous the same applies to the reflected waves. Hence the curves for P_cP and S_cS must be bent upwards throughout. In the case where a pulse is triplicated owing to a rapid increase of velocity with depth, the time curve will have cusps at both turning points. R. S. R.

560. Scales of Seismic Intensity. C. Davison. *Seismological Soc. of America, Bull.* 23. *pp.* 158–166, *Oct.,* 1933.—Details of twelve scales are given with a summary table of all 39 so far discussed. C. A. S.

561. Travel Time of Earthquake Waves. Part V. K. Wadati and K. Masuda. *Geophys. Mag., Tokyo,* 7. *pp.* 269–290, *Nov.,* 1933. *In English.*—Reference is made to the results obtained in earlier papers [see Abstract 5236 (1933)]. In the present paper tables are given for the waves P, S, pP, PP, sS, PS, pPP, sP, pS, SP, SS, PPP, sSS, and SSS, and the results are shown also in a diagram for focal depths of 0, 240, and 500 km. The tables were obtained by combining (1) the tables of travel times for the seismic wave P for near earthquakes of various focal depths ($\Delta < 1500$ km), (2) the Japanese mean time-distance curve for a distant earthquake of surface origin ($\Delta < 100°$), and (3) the reduced time-distance curve of S ($\Delta < 100°$). These tables and diagrams giving complete time-distance curves of shallow and deep-seated earthquakes although based on Japanese data are considered to be suitable for use in other places. A comparison of results with those obtained by Scrase [see Abstract 3746 (1931)] for focal depth give only approximate agreement which the author ascribes to the differences of Knott's values for the travel times of the first phase P from the Japanese values. R. S. R.

562. Earthquakes with Foci many Hundred Kilometres Deep. B. Gutenberg. *Geolog. Rundschau,* 24. 3–4. *pp.* 229–239, 1933. *Special Reprint.*—The author first reviews the historical evidence regarding earthquakes with deep foci, the types of waves produced and their speeds of propagation, the energy of the waves and the use of reflected waves to obtain the depth of focus. Diagrams illustrate the results obtained at Pasadena with earthquakes of abnormal focal depths and the close agreement between the observed and calculated values. The location of these earthquakes in 1932 agrees well with that found by Turner. Finally possible causes of these earthquakes, the yielding of the earth's mass, and the possible intrusion of a colder mass into something less cold are discussed. R. S. R.

563. Epicentre of Hawke Bay (New Zealand) Earthquake and Travel-Time Curves of Condensational Waves. C. G. Dahm. *Seismological Soc. of America, Bull.* 23. *pp.* 139–157, *Oct.,* 1933.—From the records of eight stations distant Δ 2·44°–95·34°, the epicentre was determined as 176° 56′ 8″ E., 39° 28′ 57″ S., and the time Feb. 2nd, 1931, 22h. 46m. 34·9 sec. G.M.T. [see Abstract 539 (1933)]. There were three shocks (*a*) small, (*b*) intermediate, 6 secs. later; and (*c*) the most violent 8 secs. after (*b*). P_n in the shadow zone is recorded as a comparatively weak phase, but P' is generally well recorded especially beyond the shadow zone, the whole curve being strictly continuous, though distinguished as P'_1 outside that zone, where it is followed by a second phase, P'_2 with a distinguishable travel-time curve from about Δ 143° [see Abstract 3663 (1930)]. Arrival times for P_n (Δ 1·72–140°) and P'_1, and P'_2 (Δ 107–179°) for all possible stations are given, the three shocks being frequently distinguishable; and also travel-time curves for P_n (75°–140°), P'_1 (115°–180°), and P'_2 (150°–180°). C. A. S.

564. Errors in Calculations of Epicentral Distances in Earthquakes. K. E. Bullen. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 190–201, *Jan.,* 1934.—The author has obtained the constants of 365 seismological observatories to four decimal places. For near earthquakes distances are required to 1–2 km, an accuracy which cannot be obtained when three-figure values of the constants are used while four-figure constants seemed likely to be adequate. An analysis is given in the paper of the various sources of error which can occur in the determination of epicentral distances (Δ) of observing stations. In a table are set out the standard and maximum errors in Δ when four-figure tables are used for values of Δ up to 120° when employing two different formulae. The necessity for using six-figure tables for small values of Δ is shown where a high degree of accuracy is required. The theory is illustrated by a calculation of the distance of Wellington from the epicentre of the New Zealand earthquake of 18th July, 1927. R. S. R.

565. Advantages of Using Geocentric Latitude in Calculating Distances. B. Gutenberg and C. E. Richter. *Gerlands Beitr. z. Geophys.* 40. 4. *pp.* 380–389, 1933. *In English.*—The error in the value of Δ and hence in travel-time curves, due to the use of geographic (β) instead of geocentric (α) latitudes [$\tan\alpha = (1-e^2)\tan\beta$], resulting in a maximum error of 23′ in Δ between two stations in approximately 45°N. and 45°S. is emphasised, and a table of geocentric latitudes of 185 stations is given. It is urged that in future in all seismological calculations geocentric latitude be used, variations of radius be taken into consideration, and arc distances be given in terms of the sphere of 40,000 km. circumference. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

566. Phase of the Semi-Diurnal Component of the Electric Potential Gradient. R. Guizonnier. *Comptes Rendus*, 197. *pp*. 1682–1683, *Dec*. 13, 1933.—Using the same method as before [see Abstract 4020 (1933)] the semi-diurnal component has been extracted for Val Joyeux, Ebre, Johannesburg, Samoa, Christchurch (New Zealand) and Stanford. All show minima at 2h. and 14h. and maxima at 8h. and 20h. local time. The phase is constant for the whole year especially near the equator. R. S. R.

567. Aerial-Earth Current. Part IV. H. Noto. *Phys. Math. Soc., Japan, Proc.* 15. *pp*. 449–462, *Dec*., 1933. *In English*.—Further examination was given to possible sources of error in the measurement of this current. The order of the effects due to the charge separated by the splashing of the raindrop and by the vibration of the aerial caused by the gustiness of the wind was negligibly small even when compared with weak atmospherics. Other causes, such as the polarisation of the earth plate by rainfall, charges produced by changes of tension due to thermal expansion, charges due to radio-active deposits on the aerial, rectified current of the radio-overcasting wave by the cuprous oxide deposit formed on the aerial and that of photoelectricity are negligibly small and are not of an alternating character. With rain or snow, the effect of the charge carried by them is more important. The respective magnitudes are: (1) for vibration of the aerial $3{\cdot}1 \times 10^{-9}$ ampere, (2) splashing effect $0{\cdot}39 \times 10^{-9}$ ampere, and (3) for charges of raindrops or snowflakes $0{\cdot}23 \times 10^{-6}$ and $0{\cdot}4 \times 10^{-6}$ ampere respectively in the extreme cases. [For Part III see Abstract 4836 (1933).] R. S. R.

568. Observation of Aurora at Scoresby Sound during the Polar Year. A. Dauvillier. *Comptes Rendus*, 197. *pp*. 997–1000, *Oct*. 30, 1933.—After detailing the method of observation and the scale of intensity used in recording the observations of the aurora, the author proceeds to discuss the results. The latter show that the aurora has been nearly permanent during the auroral year. From a study of a large number of characteristic forms, a marked diurnal variation in frequency is found, with two maxima, a principal at 21h. and a secondary at 4h. 30m. local time, but on dividing the day into two periods of 12 hours each, the mean auroral frequency is about the same in each. The curve of auroral activity in agreement with that of magnetic activity, indicates an irregular variation in the last quarter of 1932, but a very regular periodicity in the early months of 1933. If it be compared with the curve of solar activity, the two are found to be in opposite phase. It is the first time that a difference in time of half a solar period has been noticed between these phenomena. This result is seen to be of considerable importance and a mechanism for the production of the auroral phenomena in accordance with the observations is suggested. A. E. M. G.

See also Abstracts 541, 569, 618, 619, 620, 621, 813.

RADIOACTIVITY.

569. Electrode Deactivation Time-Curves in Measurements of Atmospheric Radioactivity. M. Boriosi. *N. Cimento,* 10. *pp.* 286–297, *July,* 1933.—The dependence of the form of the deactivation curves of the collecting electrode, on the time of collection of the radioactive matter in the atmosphere, is examined. Tables of the coefficients $a(t)$ and $b(t)$ [see Abstract 1424 (1933)] are drawn up and the contributions of the various radioactive elements are found. An artifice is described by means of which any one curve may be derived from any other.
F. C. C.

570. Half-Value Period of Thorium. H. Fesefeldt. *Zeits. f. Physik,* 86. 9–10. *pp.* 605–610, *Nov.* 28, 1933.—The paper describes the determination of the number of α particles emitted per sec. by one gm. of Th. Samples of thorium oxide of various strengths were prepared from a specimen of pure thorium nitrate of known age and the number of α-particles emitted per sec. by each sample was determined by means of a tube counter. It was found that the number emitted by one gm. of Th per sec. is $4 \cdot 7 \times 10^3$. This value agrees with that obtained by Geiger and Rutherford by the scintillation method but not with the results of other observers who used electrometer methods. The decay constant of Th calculated from the result is $5 \cdot 6 \times 10^{-11}\ y^{-1}$ and the half-value period is $1 \cdot 3 \times 10^{10}\ y$.
W. E. P.

571. Radioactivity of Zinc. H. Fesefeldt. *Zeit. f. Physik,* 86. 9–10. *pp.* 611–614, *Nov.* 28, 1933.—Ziegert [see Abstract 1314 (1928)] observed that the residue from solutions of Zn emitted α-particles. The author dissolved 1 kg. of Zn in HCl, HNO_3 and H_2SO_4 respectively and investigated the radioactivity of residue by means of a Geiger counter. It was found that 0·01 to 0·05 α-particles were emitted per hour by the residue per gm. of dissolved Zn. This is about one-tenth of the number calculated from Ziegert's observations. The result is attributed to the fact that the sample of Zn chosen was particularly free from radioactive impurities.
W. E. P.

572. Thorium Minerals as Age Indicators. R. C. Wells. *Washington Acad. Sci., J.* 23. *pp.* 541–544, *Dec.* 15, 1933.—Uraninite is altered as easily as, if not more so than, monazite or thorianite. Instances of apparent loss of uranium faster than of lead are quoted, and it is urged that this is a more probable explanation of disagreement between the ratios RaG/U and ThD/Th than the leaching out of one isotope of Pb in preference to another [see Abstracts 5060 (1932) and 3882 (1933).]
C. A. S.

573. Radioactive Radiations from the Surfaces of Solids and the Measurement of the Thorium Content of Rocks. R. D. Evans. *Phys. Rev.* 45. *pp.* 38–42, *Jan.* 1, 1934.—Ordinary granite, containing *ca.* 3×10^{-6} gm. U per gm. and *ca.* 6×10^{-6} gm. Th per gm. of rock, will support an ionisation current of *ca.* 10^{-15} ampere per 100 cm^2. of polished rock surface. About 90 % of this ionisation is due to α-rays from the rock, and about 10 % to β-rays. From hand specimens the α-radiation is too feeble to operate an ionisation chamber, but can be measured with a Geiger-Müller tube-counter. Observations of the surface ionisation due to α-rays, or of the γ-ray activity with the tube-counter, represent the combined effect of the U, Ac and Th series. They can be corrected for the effects of the U and Ac series by employing emanation measurements, and thus the Th content of ordinary rocks may be obtained. Important applications lie in the field of geophysics and in certain cosmic-ray problems. [See Abstract 575 (1934).] AUTHOR.

574. Fractional Crystallisation of Radiferous Barium Chloride. (Mrs.) B. E. Marques. *Comptes Rendus*, 197. *pp*. 1314–1315, *Nov*. 27, 1933.—If λ is defined by the relation log [(Ra″ in solution before crystallisation)/(Ra″ in solution after crystallisation)] = λ log (Ba″ in solution before crystallisation)/(Ba″ in solution after crystallisation)], its value decreases very slightly (3·36–3·18) as the proportion of radiferous $BaCl_2$ rapidly crystallising out with agitation increases from 10·52 to 50·89 % [see Abstract 172 (1931)]. C. A. S.

575. Measurement of Natural α-Particles Ejected from Solids. R. D. Evans. *Phys. Rev.* 45. *pp*. 29–37, *Jan*. 1, 1934.—Exact expressions for the ionisation due to α-particles from radioactive solids are set up and the results of their graphical integration are given. The total ionisation per cm². of surface, both with and without absorbers; the variation of ionisation with height above the radioactive surface; the ionisation from thin films and from substances containing all members of the U, Th and Ac series, both with and without absorbers; and the counting rate for α-particle counting chambers, are given in equations accompanied by graphs and tables. The older approximate theories break down for actual α-particles, particularly those of short range. If q is the number of ion pairs per cm². per sec. formed above the surface of a radioactive solid; N, the number of α-particles per sec. per cm³. emitted in the solid; k, ion pairs per α-particle of range R in air; and R' the α-particle range in the solid: then $q = \epsilon NkR'$, and the numerical coefficient ϵ has values between 0·114 and 0·150 for the α-particles from all known radioactive substances. [See Abstract 573 (1934).] AUTHOR.

576. Scattering of Hard γ-Rays. V. Trkal. *J. de Physique et le Radium*, 4. *pp*. 665–676, *Nov*., 1933.—The theory applicable to Neukirchen's method of determining the mass-scattering coefficient is given in detail, and his equation for the intensity of γ-rays after passing through a thickness, d, of material [$I_d = I_0(1 + d)e^{-d}$] is shown to be incorrect. Revised equations for this and for determining σ_a are deduced. C. A. S.

577. Secondary Radiation Produced by the Incidence of Hard γ-Rays on Matter. T. Heiting. *Zeits. f. Physik*, 87. 1–2. *pp*. 127–138, *Dec*. 13, 1933.—The elements Al, Fe, Cu and Pb were irradiated with the γ-ray line λ = 4·7 X from Th C″. The secondary radiation emitted was examined by the ionisation method at a scattering angle of 130°. Besides the well-known Compton component of the scattered radiation another homogeneous radiation was observed. The wave-length was independent of the atomic number of the scattering element and was equal to 23·8 ± 1·0 X, which is that which would be produced if an electron were annihilated. The intensity of the radiation per atomic nucleus was proportional to the square of the atomic number. With Pb as scatterer, a second component of wave-length 6 to 7 X was found: this probably has its origin in nuclear resonance. F. C. C.

See also Abstracts 655, 798.

RADIATION.

ABSORPTION AND TRANSMISSION.

578. Atmospheric Transparency and the Oxygen Absorption Spectrum. J. Duclaux. *J. de Physique et le Radium*, 4. *pp.* 625–637, *Nov.*, 1933.—Highly transparent masses of air are found near the earth, and have been purified by rain; this condition does not hold good for very high altitudes. Hence absorption minima corresponding to molecular diffusion or true absorption should be measured in this purified air. The relation of the continuous oxygen spectrum to the cutting off of the solar spectrum is discussed. N. M. B.

579. Transmission of Light through Cloud Particles. Part III. D. Nukiyama. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 98. *pp.* 61–100, *Dec.*, 1933. *In English.*—A photographic method of measuring the relative intensity distribution of scattered rays from a cloud of particles is described, NH_4Cl and incense being again used [see Abstract 4920 (1932)]. Vector diagrams are used to show the energy distribution for white light and for 4600, 5100 and 5600 Å. The minimum scattering found at certain angles does not agree with theory. The results are difficult to interpret because of (1) the effect of changes of wave length, (2) lack of uniformity in particle size, (3) doubt regarding the assumptions for conductivity and dielectric constants of the particles, (4) multiple scattering, and (5) the density of the cloud being too great. Generally the backward scattering diminishes as the wave length of the incident light increases. The resulting theoretical and experimental curves are very similar but for longer wave lengths of the incident light, the point of minimum scattering becomes less definite than for shorter wave lengths. The experimental results indicate that the amount of scattered energy is far greater than theory predicts. No numerical relation between transmission and the results obtained, could be established because the absolute scattered energy was difficult to find. The minimum transmission was also difficult to find because the law of transmission which is a function of the nature and radii of the particles is complicated with the absorption of light and this depends upon the nature, radii and density of the particles and the wave length of the light. Great difficulty was experienced in maintaining constant uniformity of the particles. [For Part II see Abstract 2345 (1933).] R. S. R.

580. Colours of Copper Salts. W. D. Bancroft and H. W. Rogers. *J. Phys. Chem.* 37. *pp.* 1061–1073, *Nov.*, 1933.—The colours of a large number of copper salts have been studied and it is shown that the colours of solid, solution and vapour are identical when the chromophoric groups are the same in all three states. The colour of a chromophoric group is almost independent of the degree of ionisation, but becomes less intense with falling temperature. The anhydrous cupric ion is colourless and the red colour of cupric chloride vapour is interpreted as indicating that the vapour contains a pseudo-salt. Similar chromophoric groupings must exist in the red anhydrous double salts of $CuCl_2$ with NH_4Cl, CsCl, and KCl. Anhydrous cupric chloride (yellow-brown) must contain copper as part of the acid radical. In a corresponding way, conclusions are drawn as to the structure of hydrated double chlorides and other salts. C. B. A.

581. Coloration of Fluorides by Kathode Rays. H. Nagaoka, Y. Sugiura and T. Mishima. *Imp. Acad. Tokyo, Proc.* 9. *pp.* 486–489, *Nov.*, 1933. *In English.*—The colour of fluorite and a number of other fluorides is changed by kathode ray bombardment. The dependence of the coloration of fluorides on the velocity of the incident kathode rays is measured by colorimeter methods. The curve connecting coloration and velocity shows marked changes of slope at voltages which correspond to the excitation of the K, L, M, etc., radiations of fluorine and the elements combined with it. If the coloration is proportional to the range of penetration of the kathode rays it appears that the α-particle law, $R = kV^{3/2}$ also holds for kathode rays. The origin of coloration is not yet clear but it is probably due to dissociation of fluorine from the compounds. J. E. K.

582. Polychroism of Iceland Spar in the Infra-Red. P. le Roux. *Ann. de Physique,* 20. *pp.* 518–535, *Dec.*, 1933.—Experiments are carried out to show that the absorption by Iceland spar of infra-red waves, in which region of the spectrum it is polychroic, is independent of the direction of propagation and depends only on the direction of the luminous vector as would be expected from theory. Measurements are made with a spectrograph having rock-salt prism and mirrors and a thermopile for measuring the transmission. Four specimens are examined and results are similar to those for other crystals in the visible spectrum [see Abstracts 1824 (1929) and 103 (1930)]. In the region 2·2μ to 4·4μ, the coefficient of absorption of the ordinary ray for pieces cut parallel to the axis is always a little greater than for those cut perpendicular. As the absorption increases, the difference increases, but it is always feebler than that of tourmaline in the visible and ultra-violet. H. M. B.

583. Influence of Foreign Gases on the Intensity of Infra-Red Absorption. P. C. Cross and F. Daniels. *J. Chem. Phys.* 2. *pp.* 6–10, *Jan.*, 1934.—Measurements have been made on the effect of helium, argon, oxygen, nitrogen, ethane, carbon dioxide and hydrogen on the maximum absorption by nitrous oxide in the region of 4·5μ, by using a spectrometer of low resolving power. Some measurements have also been made with carbon monoxide and ethyl bromide as the absorbing gases. Relative "optical" collision diameters, calculated on the postulate that the mean free paths are equal in gas mixtures having the same relative absorption coefficients, show a linear relationship with the gas-kinetic diameters as determined by viscosity measurements. The applicability of Beer's law is discussed in connection with the use of infra-red absorption measurements as a means of analysis. AUTHORS.

584. Absorption of Light near Mercury Resonance Line, 1850 Å. J. M. Frank. *Phys. Zeits. d. Sowjetunion,* 4. 4. *pp.* 637–645, 1933.—The absorption of the aluminium line, 1854 Å, by mercury vapour has been measured. The results are interpreted as suggesting that the absorption is associated with light scattering, and that mercury atoms (not molecules) play an essential part in the process. C. B. A.

See also Abstracts 585, 597.

COLORIMETRY.

585. Microscopic Study of Pigments Using Ultra-Violet Light. G. S. Haslam and C. H. Hall. *J.O.S.A.* 24. *pp.* 14–18, *Jan.*, 1934.—The idea of using the ultra-violet microscope in order to study the component parts of two pigment systems was suggested by Green some years ago. The development of the technique to the necessary degree of refinement has been slow but seems now to have reached a point where valuable information is obtainable. This article shows photomicrographs of lithopone, titanium-barium, titanium-calcium pigments in which the ZnS or TiO_2 is pictured as opaque particles and the barium or calcium sulphate as transparent particles. This permits the investigator to study the relative size of each component as well as the amount of coalescence. [See Abstract 3404 (1930).] AUTHORS.

586. Artists' Colours Based on Trichromatic Colour System. H. E. Ives. *Phys. Soc., Proc.* 46. *pp.* 16–34, *Jan.* 1, 1934.—The author shows how, on the basis of Young's trichromatic colour theory, it is theoretically possible to imitate all possible colours occurring in nature by using mixtures of four pigments, *viz.*, white, minus red, minus green and minus blue. The minus red pigment must absorb strongly in the red, but as little as possible in the other parts of the spectrum and similarly for the minus green and the minus blue. In order to test the theory the author has examined the available pigments and selects (*a*) zinc white, (*b*) Chinese blue, (*c*) a phospho-molybdo-tungstic acid lake of rhodamine 6-G, and (*d*) extra pale cadmium yellow. These are satisfactory as regards permanence but the technique to be followed in mixing them to produce any desired colour is different from that normally followed in painting with a large number of pigments. J. W. T. W.

See also Abstracts 685, 686.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

587. Magneto-Optical Investigations on Ferric Oxide Sols. Part I. General. W. Heller. *Kolloid-Beihefte*, 39. 1–4. *pp.* 1–57, 1933. —With increasing strength of the magnetic field, ferric oxide sols may show positive, negative, and positive-negative optical properties. The sign of the magneto-optical anisotropy may change as a result of either natural ageing or artificial alteration of condition. The complicated character of these relationships is explainable partly by varying chemical composition of the disperse phase and partly by the remarkable magneto-optical behaviour of chemically individual goethite sols. It is probable that three colloidal substances, showing magneto-optical activity, differing chemically, and capable of inter-conversion, may be present in ferric oxide sols, namely, α-FeOOH, α-Fe_2O_3, and a basic salt. α-Fe_2O_3 and the basic salt always show invariable positive effects, which increase with the strength of field in characteristically different ways. On the other hand, goethite sols may show positive, positive-negative, and negative double refraction, the effect being always positive at first, becoming negative with increasing age. The preponderance of one or other of these compounds depends on the conditions under which the sol has formed. T. H. P.

588. Thermal Variation of Magnetic Birefringence of Nitrobenzene, Benzene and Carbon Bisulphide. A. Goldet. *Comptes Rendus*, 197. *pp.* 1612–1614, *Dec.* 13, 1933.—Three liquids have been examined under identical conditions and the relative variations of birefringence measured. Near 20° C. they are found to be 1/144·6 per degree for nitrobenzene, 1/400 for benzene, and 1/235 for carbon bisulphide. Curves are given showing the variation of ellipticity with temperature for the three liquids between 0° and 100° C. The results are compared with those calculated from Langevin's theory substituting in turn the invariants calculated according to the Lorentz-Lorenz formula and that of R. de Mallemann. The variation of the supposed invariants with temperature is given. R. L.

589. Magnetic Birefringence of Gaseous Oxygen. T. Belling. *Comptes Rendus*, 197. *pp.* 1615–1616, *Dec.* 18, 1933.—Experiments on the magnetic birefringence of bodies in the gaseous state have considerable theoretical interest. The author employs gaseous oxygen under pressures of 25-100 atmospheres in fields of about 45,000 gauss. It appears that the compressed oxygen acquires under the action of the magnetic field a negative birefringence proportional to the pressure. The values obtained are considerably less than those anticipated on the classical Langevin-Debye theory. Further more precise measurements are in progress with a view to comparing the values of the birefringence in both the gaseous and liquid state, already determined by P. Lainé [see Abstract 3487 (1933)], with theoretical predictions. R. L.

See also Abstracts 591, 681.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

590. Thermoluminescent Spectra of Fluorites. Part I. E. Iwase. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 461. *pp.* 233–241, *Nov.*, 1933. *In English.*—A continuation of previously published work on fluorites from Oita Prefecture. In the present work a further study on the relation between the thermoluminescence spectra and the photo-luminescent power has been undertaken, employing various specimens from the same locality. The conclusion is drawn that the luminescence depends on the rare-earth content. A number of spectra are reproduced together with the corresponding photometer curves. J. E.

591. Magnetic Extinction of S_2 Fluorescence. J. Genard. *Comptes Rendus*, 197. *pp.* 1402–1404, *Dec.* 4, 1933.—Fluorescence of S_2 vapour is excited by means of a very intense Hg lamp in a small quartz bulb 6 mm. in diameter. This bulb, enclosed in a furnace whose temperature and pressure can be regulated, is placed in the air gap of a very large electro-magnet. The light emitted is photographed simultaneously in the visible and ultra-violet regions. The results are very complicated. Some lines are extinguished, some are unaffected, and others are intensified by the field. More complete measurements will be published later. A tentative theoretical explanation is given. [See Abstract 4873 (1933).] R. L.

592. Extinction of Fluorescence by Organic Compounds. K. Weber and M. L. Sarič. *Zeits. f. phys. Chem.* 24. *Abt. B.* 1. *pp.* 68–74, *Jan.*, 1934.—The influence of the solvent upon the extinction of fluorescence, consists usually of a displacement of the extinction curves the direction being similar for different extinguishing materials [see also Abstracts 4962, 4963 (1932)]. In this paper, the influence of a series of organic compounds containing —OH and —NH_2 groups upon the extinction of the fluorescence of sodium naphthionate in water, quinine sulphate in normal aqueous sulphuric acid, pinacryptol yellow in water and in ethyl alcohol, fluorescence in benzene, and esculin in ethyl alcohol, has been investigated. The dimensions of the active-sphere are determined by the properties of the fluorescent substance, and are independent of the extinguishing substance used. The degree of extinction depends on the separate combination used for the purpose. H. H. Ho.

See also Abstract 659.

INTERFERENCE. DIFFRACTION AND SCATTERING.

593. Interference Scheme for Measuring the Cell Depth of a Siedentopf Ultramicroscopic Counting Chamber. D. L. Gamble and A. H. Pfund. *J.O.S.A.* 23. *pp.* 416–418, *Dec.*, 1933.—A method is described of measuring the depth of a cell of the order of 10 microns thick by producing multiple reflections between the inner faces of the cell. The faces are sputtered slightly to increase their reflecting power and when the reflected beams are viewed through a spectroscope, interference fringes are seen through the spectrum. The frequency of the fringes gives a measure of the thickness of the cell. W. D. W.

594. Visibility Curves of a Michelson Interferometer. E. J. M. van der Slooten and C. Janssen. *Zeits. f. Physik*, 86. 11–12. *pp.* 760–764, *Dec.* 7, 1933.—Using the red cadmium line 6438 Å, visibility curves of a Michelson interferometer (temperature constant to 0·1° C.) are determined by a photographic-photometric method. It is found that the curves obtained in this way do not coincide with Michleson's curves, except when the light incident on the instrument is plane polarised. The authors can give no explanation of the discrepancies. L. A. W.

595. Molecular Scattering of Light in Binary Mixtures. R. Gans and H. A. Stuart. *Zeits. f. Physik*, 86. 11–12. *pp.* 765–777, *Dec.* 7, 1933.—After a short discussion of present theoretical knowledge of the connection between the degree of depolarisation and the optical anisotropy of mixtures, measurements made by **W. Müller** are given of the degree of depolarisation in the following binary mixtures: benzene-hexane; CCl_4-benzene; nitrobenzene-CCl_4 and nitrobenzene-hexane. From the measurements on the mixture CCl_4-C_6H_6 where all necessary data are known it is found that contrary to the statement by Rav the anisotropy of a mixture cannot be calculated according to the mixture rule. J. J. S.

596. Grayson's Micro-Rulings. W. Stone. *Journ. Sci. Instruments*, 11. *pp.* 1–6, *Jan.*, 1934.—Details of the technique developed by Grayson for producing micro-rulings on realgar films are given, and his machine is described. The paper includes some notes on interesting defects met with in the ruling, as well as some historic notes about Grayson and his work. AUTHOR.

See also Abstracts 579, 630, 631.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

597. Actinometry with Uranyl Oxalate at $\lambda\lambda$278, 253 and 208 $m\mu$. F. P. Brackett, Jr., and G. S. Forbes. *Am. Chem. Soc.*, J. 55. *pp.* 4459–4466, *Nov.*, 1933.—The photolysis of uranyl oxalate, using a zinc spark, has been investigated, with elaborate radiometric and analytical precautions, and the quantum yield at 208$m\mu$ measured. The gross quantum yield ϕ gross at 27 ± 2° for a solution $0{\cdot}01M$ in uranyl sulphate and $0{\cdot}05M$ in oxalic acid is found to be $0{\cdot}48 \pm 0{\cdot}01$ at 208 $m\mu$, whilst a redetermination of the gross quantum yields at 253 $m\mu$ and 278 $m\mu$ gives values of $0{\cdot}63 \pm 0{\cdot}03$, and $0{\cdot}59 \pm 0{\cdot}01$ respectively. After correction for light absorbed by uncombined oxalic acid, and for the unsensitised photolysis of this acid the quantum yield, with $\lambda = 208\ m\mu$, is considerably higher than at the lower frequencies. The uranyl oxalate actinometer should be especially valuable for photochemical work in the region of $\lambda = 208\ m\mu$, and the precautions necessary for work in this part of the spectrum are emphasised. The results obtained for ϕ_{253} and ϕ_{278} agree closely with those obtained by Leighton and Forbes [see Abstract 665 (1931)], thus indicating that the two thermopiles used and the uranyl oxalate actinometer integrate, in an equivalent manner, both periodically intermittent and constant radiations. R. C. F.

598. Action of Light on Rubidium Iodide Vapour. G. H. Visser and A. C. S. van Heel. *Zeits. f. Physik*, 86. 9–10. *pp.* 694–696, *Nov.* 28, 1933.—In a remark upon a paper on this subject by Desai [see Abstract 4882 (1933)] the authors compare his results with those obtained in an earlier paper by themselves [see Abstract 4032 (1931)]. In general, his experiments confirm theirs and they discuss his correlation of a certain absorption region with the dissociation of RbI into Rb $(2^2P_{\frac{1}{2}}, {}_{\frac{3}{2}}) + I(^2P_{\frac{1}{2}})$. J. E. R. C.

599. Photochemistry of Solid Lithium Hydride. F. Bach and K. F. Bonhoeffer. *Zeits. f. phys. Chem.* 23. *Abt. B.* 3–4, *pp.* 256–264, *Nov.*, 1933.—Lithium hydride was prepared in an atmosphere of hydrogen, vaporised and deposited on a plate of fluorspar. The absorption spectrum showed a pronounced maximum at 2517 Å. When exposed to light a thin layer of LiH became coloured. It was concluded that the behaviour of LiH resembled that of the halogen salts of the alkali metals, in the absorption and photographic processes. F. J. B.

600. Photochemistry of Fluorescein Dyes. H. F. Blum and C. R. Spealman. *J. Phys. Chem.* 37. *pp.* 1123–1132, *Dec.*, 1933.—The peroxide formed when fluorescein dyes are irradiated in aqueous solution is probably hydrogen peroxide. It is suggested that the bleaching of the dyes by light is an oxidation of the dye by the hydrogen peroxide, this reaction requiring activation of the dye molecule by light. AUTHORS.

601. Primary Photochemical Processes. Part III. Absorption Spectrum and Photochemical Decomposition of Keten. R. G. W. Norrish, H. G. Crone and Olive Saltmarsh. *Chem. Soc., J. pp.* 1533–1539, *Dec.*, 1933.—The photochemical decomposition of monomeric keten vapour occurs in light of the mercury lamp. The products are two volumes of CO and one of C_2H_4. The absorption spectrum of keten vapour consists of a series of completely diffuse bands, occurring fairly regularly between 3700 and 2600 Å, the region of maximum absorption occurring round 3100 Å. The primary change is simply interpreted as a splitting of the molecule at the olefinic bond, according to the equation $CH_2{:}CO + h\nu = CH_2 + CO$, the liberated CH_2 molecules reacting further with undecomposed keten, to give ethylene and carbon monoxide, $CH_2{:}CO + CH_2 = C_2H_4 + CO$. The character of the spectrum suggests that light is first absorbed by the carbonyl group, and that an energy switch occurs to the olefinic group, with the consequent rupture of the molecule. The energy relationships of the primary change when analysed show that it cannot be represented purely as a rupture of the olefinic bond; they are, however, consistent with a decomposition into CH_2 and CO molecules, each containing carbon in the bivalent form. It is suggested that the decomposition can be simply visualised as taking place in one act by a rearrangement of the electrons constituting the olefinic bond. The photochemical change is further discussed in terms of potential-energy diagrams. [For Part II see Abstract 1854 (1933).] AUTHORS.

602. Photochemical Action of Complex Radiations. M. Padoa and N. Vita. *Zeits. f. wiss. Phot.* 32. *pp.* 185–195, *Dec.*, 1933.—Winther's criticisms [see Abstract 1855 (1933)] of the author's investigations on this subject are discussed and shown to be without foundation. T. H. P.

603. Combination of Hydrogen with Chlorine under High Light Intensity. V. Kokotschaschwili. *Zeits. f. phys. Chem.* 23. *Abt.B.* 5–6. *pp.* 431–444, *Dec.*, 1933.—By means of a special manometer with a glass membrane a method for studying the velocities of reaction and explosion of $H_2 + Cl_2$ under the action of a short, highly intense illumination (magnesium flash) has been developed. The results obtained show some discordance, owing to variations in the duration of the combustion of the magnesium, uncertainty in determining the intensity of the light, and difficulty in calculating the velocity of reaction. The following conclusions must hence be regarded as tentative. In the beginning the velocity of reaction is proportional to the light intensity, $w = I/\beta$, where β represents the (constant) probability of chain-rupture owing to impact with oxygen molecules. Increase of the velocity with the intensity then slackens and later rises steeply. This rise may have one of two causes : increase in the change-length and reaction velocity by the elevation in temperature produced by the heat of the reaction, or acceleration resulting from the chain-branchings occurring at high velocities. T. H. P.

604. Influence of Chemical Bonds in Triatomic Molecules upon Photochemical Processes and Other Properties. K. Butkow. *Phys. Zeits. d. Sowjetunion.* 4. 4. *pp.* 577–605, 1933.—The absorption spectra of the vapours of zinc iodide, lead iodide, lead bromide, and lead chloride, have been investigated in the region between 7000 Å and 1950 Å. Consideration of the boiling temperatures and ionisation potentials enables triatomic molecules of the type MX_2 (M, metal ; X, halogen) to be arranged in a series according to increasing polarity of the bond, *viz.*, HgX_2, TeX_2, BeX_2, NnX_2, CdX_2, PbX_2, MgX_2, CaX_2, SnX_2. The first ionisation potential of the Te atom has been obtained (10·3 volt) by interpolation using the above regularity. For feebly polar triatomic molecules MX_2, it is shown that on photo-dissociation at least one of the activated decomposition products is neutral ; strongly polar triatomic molecules PbX_2 can also be decomposed by photo-dissociation into non-activated components. By comparison of the spectra of MX_2-vapours with the corresponding absorption spectra of solutions, definite conclusions respecting the nature of aqueous and alcoholic solutions have been derived. A regularity between the position of the absorption bands of the vapours and crystals of MX_2 and the ionic dimensions has been established. Thermodynamic data for the dissociation energies of the halides of lead, cadmium, zinc, and mercury, indicate a connection between these energies and the deformation of the molecules. The conclusions of Kimura and Ochida [see Abstract 3740 (1932)] are probably invalid. H. H. Ho.

605. Photographic Summation Law and its Region of Validity. A. van Kreveld. *Physica,* 1. *pp.* 60–77, *Dec.*, 1933. *In German.*—In consequence of the Herschel and Becquerel effects the possibility exists that the blackening of a photographic plate by two colours is not purely additive. The author sought to investigate these possibilities experimentally. He has formulated, independent of any theory of the curve of blackening, a quantitative law and with it, calculation of the curve for mixed colours can be made from the blackening curve of monochromatic colours. The correctness of this law is confirmed by experiments under several different conditions. The independence of the Schwarzschild indices of the colour results from this law. The theoretical interpretation of the summation law shows the independence of the action of different colours which illuminate the photographic plate simultaneously.

R. S. R.

606. Correction of Curves of Photographic Density Measured with Microphotometer. P. Jacquinot and M. Meunier. *J. de Physique et le Radium,* 4. *pp.* 570–575, *Oct.,* 1933.—When the detail on a photographic plate is fine, so that the density gradient is frequently high, the curves of density obtained with a microphotometer need correction to allow for the smoothing effect of the "slit-width" of the instrument. This is especially the case when a spectrograph of a fine line spectrum is being measured. The effect is analogous to the slit-width effect in finding the intensity distribution in a non-continuous spectrum by means of a spectrophotometer having a slit of finite width. The authors examine several different methods of calculating the correction to be applied and then describe a method which they have devised. They give two examples from which it is possible to estimate the amount of work involved in applying the method to spectrographs of different degrees of complexity.

J. W. T. W.

607. Irregularities in Density of Photographic Plates. P. Bricout. *Comptes Rendus,* 197. *pp.* 1202–1204, *Nov.* 20, 1933.—A method is described for examining variation of density in a photographic plate, and determining the errors due to the granulation of the emulsion, diffraction and other disturbing factors. W. R. A.

608. Sensitisation by Sodium Sulphite. B. H. Carroll and D. Hubbard. *Bureau of Standards, J. of Research,* 11. *pp.* 743–764, *Dec.,* 1933.—Sodium sulphite, in quantities sufficient to reduce a few tenths per cent of the silver bromide of a photographic emulsion, may act as a powerful sensitiser only slightly inferior to the natural sensitisers in gelatin. It acts as such only after digestion with the emulsion, insuring that it has reacted with the silver bromide. The sensitivity nuclei thus formed are of metallic silver, in amounts similar to the silver sulphide nuclei of normal emulsions. The rate of change of sensitivity increases with increasing alkalinity and decreases with increasing bromide-ion concentration. Sulphite may be added to the emulsion before washing, sensitising only on digestion after washing. There is no indication of panchromatic sensitisation (Capstaff effect). AUTHORS.

609. Distortion of Photographic Emulsions. Part I. Plates. G. Berndt. *Zeits. f. Instrumentenk.* 53. *pp.* 510–514, *Dec.,* 1933.—The distortion produced in photographic emulsions has been determined by copying a suitable geometrical pattern on to 7 different types of plate. Measurements with a micrometer microscope have given the displacements of the image along the centre lines, diagonals and edges of the plate. The results for each type of plate are shown graphically. W. D. W.

610. Reflection Densitometer. J. W. McFarlane. *J.O.S.A.* 24. *pp.* 19–24, *Jan.*, 1934. *Comm. No.* 516 *from the Kodak Research Lab.*—A reflection densitometer designed primarily for research and product control on photographic printing papers is described in detail. It can be used also in connection with photo-mechanical half-tone reproduction work. Simplicity of design and relatively low cost of construction is combined with precision ample for all practical purposes. The paper concludes with a short description of factors influencing the measurement of reflection density. AUTHOR.

611. Weigert Effect. W. Kemula. *Zeits. f. phys. Chem.* 23. *Abt.B.* 3–4. *pp.* 305–314, *Nov.*, 1933.—The influence of the gelatin, of the concentration of dye-stuff, and of the colour of the exciting light on the variation of photodichroism with wave-length is studied with dyed gelatin plates irradiated with white and with monochromatic plane-polarised light (Weigert effect). The influence of the concentration of the dye is attributed to the existence of two modifications of the colouring matter and to its filtering effect. C. B. A.

612. Diagrammatic Representation in Photography. G. Maass. *Zeits. f. wiss. Phot.* 32. *pp.* 196–199, *Dec.*, 1933.—The advantages of applying diagrammatic or nomographic methods to photographic problems are discussed. Two examples are considered: (1) given the distance of the nearest and most distant points to be focussed sharply, to determine the correct focussing; (2) the relation between diameter and angle of the image and the focal length. T. H. P.

See also Abstract 552.

PHOTOMETRY.

613. Portable Brightness Meter. B. H. Crawford. *Journ. Sci. Instruments*, 11. *pp.* 14–17, Jan., 1934.—A form of portable brightness meter or illuminometer is described working on the principle of variation of the candle-power of the comparison lamp of the instrument. This enables the instrument to be made in a very compact form which is useful for certain purposes. Some inherent disadvantages of the instrument are discussed, and are shown to lead to errors which are not very much greater than are usual in illuminometers. AUTHOR.

See also Abstracts 594, 606.

POLARISATION.

614. Elliptic Reflection at Normal Incidence of a Transparent Anisotropic Body; Surface Birefringence of Spar. R. de Mallemann and H. Courtillot. *Comptes Rendus*, 197. *pp.* 1610–1612, *Dec.* 18, 1933.—It is stated that normally incident light may be elliptically polarised when reflected from anisotropic transparent bodies. The phenomenon is studied for Iceland spar. Relations between the amplitude of vibration and the retardation along the two principal directions of the crystal are given by the usual formulæ. It is found, however, that the retardation is constant and that the amplitude is dependent on the azimuth of the polariser. It is concluded that the reflection, even when normal, introduces a small difference of phase between the two principal reflected vibrations. Theory indicates, and this has been verified in the present experiments, that the Brewsterian ellipticity is greater when the principal direction of greater index is parallel to the plane of incidence. The phenomenon is the sum of two effects, a surface birefringence and a double reflection. R. L.

615. Optical Rotation of Unpolarised Light. A. Langsdorf, Jr., and L. A. DuBridge. *J.O.S.A.* 24. *pp.* 1–4, *Jan.*, 1934.—The question as to what happens to a beam of unpolarised light in passing through an optically active medium does not seem to have been given a definite answer. If such a beam can be regarded as made up of a large number of elementary components, each plane polarised, then each component should suffer a rotation. Consequently, if an unpolarised beam is separated into two parts and one passed through a dextro- and the other through a lævo-rotatory solution, such that the sum of the rotations is 90°, the emergent beams should be incapable of interference. With the use of a Fresnel bi-prism it was found that the interference fringes disappeared when the optically active solutions were in place. They reappeared when the field of view was examined with a quarter-wave plate, showing the existence of circularly polarised light as expected. Remarks by **R. W. Wood** are appended. AUTHORS.

616. Measurement of Vibration Ellipses of Elliptically Polarised Light of Very Great Eccentricity. C. Münster. *Zeits. f. Krist.* 86. *pp.* 325–334, *Nov.*, 1933.—A simple arrangement is described, both from the practical and theoretical standpoint for determining accurately the azimuth of vibration of (almost circular) elliptically polarised light by means of a quarter-wave plate, a Bravais double plate and an analyser. After the azimuth of vibration has been determined the eccentricity can be found by the well-known methods. The accuracy of the method was tested with a series of vibration ellipses of known azimuth and eccentricity, and the experimental errors were very small. R. L.

See also Abstracts 595, 635.

RADIATION, EMISSION.

617. Measurement of Radiation Temperature in the Ultra-Violet. F. Hoffman and H. Willenberg. *Phys. Zeits.* 35. *pp.* 1–3, *Jan.* 1, 1934.—An apparatus, embodying a double monochromator and a gas-filled photocell, is described for the measurement of the small spectral energies of the ultra-violet in the region of 0·3 μ. The method is a comparison one, a source of known spectral distribution being balanced by means of a rotating sector with the source under test. The precautions necessary to obtain accurate results are fully described. H. J. H. S.

618. Radio Observations of the Ionosphere During the Solar Eclipse of August 31, 1932. S. S. Kirby, L. V. Berkner, T. R. Gilliland and K. A. Norton. *Bureau of Standards, J. of Research,* 11. *pp.* 829–845, *Dec.*, 1933.—Radio observations of the heights of the several layers of the ionosphere were made at Washington, D. C., and Sydney, Nova Scotia, by the pulse method during the afternoon of the solar eclipse of August 31, 1932, and during the afternoons of several days preceding and following. At Washington three separate groups of determinations were made: (1) measurements of the maximum ionisation of the E-layer during the afternoon; (2) a continual series of measurements of virtual height during the afternoon at 4200 kc./s which was ordinarily just above the F_1 critical frequency for the ordinary ray; (3) measurements of the critical frequency of the F_2-layer during the afternoon. At Sydney, determinations similar to (1) were made and continuous records of virtual height were obtained at 2400 kc./s and 3000 kc./s. Separate equipment was used for each of these groups of determinations so that measurements could be made rapidly and continuously. It was found that the ionisation of the E-layer decreased to about 30 % of its normal value at the time of the eclipse maximum, the variation taking place approximately in phase with the eclipse. The ionisation of the F_1-layer likewise decreased in almost exactly the same manner, reaching a value of about 40 % of its normal ionisation at about the eclipse maximum. When analysed by the method presented in this paper, observations of other investigators are found to agree well with these results. No unusual change was evident in the F_2 critical frequency during the eclipse. No evidence of a corpuscular eclipse was found at either Washington or Sydney. AUTHORS.

619. Ionosphere and Radio Transmission. S. S. Kirby, L. V. Berkner and D. M. Stuart. *Bureau of Standards, J. of Research,* 12. *pp.* 15–51, *Jan.*, 1934.—Observations of the virtual height of the ionosphere and its variations carried out at the Bureau of Standards during the period of September, 1930, to April, 1933, are reported and discussed. The pulse method of Breit and Tuve was used with a visual recording technique developed by the Bureau of Standards. In general, a number of layers were discernible, the major daytime layers being the lower or E-layer at about 100 to 120 km. virtual height, an F_1-layer at about 180 km. virtual height, and an F_2-layer at about 240 km. virtual height. The relative electron densities of these layers were determined by measuring the critical penetration frequencies where possible. The E- and F_1-layer critical frequencies were highest at summer noon and fell off both diurnally and seasonally as the angle of the sun's rays with the vertical increased. Abnormally strong E-layer ionisation occurred occasionally at irregular intervals. The F_1-layer showed magneto-ionic splitting during the day. There was some correlation between F_1-layer ionisation and magnetic storms. The F_2 critical frequency was greatest on a summer evening, and greater on a winter noon than on a summer noon. From this evidence it is believed that the F_2 critical frequency may be determined by some other factor than penetration, such as absorption. Scattered reflections of long retardation were observed on frequencies considerably higher than the F_2 critical frequency. AUTHORS.

620. Diurnal Variation of the Intensity of Radio Waves Reflected from the Ionosphere. F. W. G. White. *Phys. Soc., Proc.* 46. *pp.* 91–106, *Jan.* 1, 1933.—An account is given of the diurnal variation of the relative intensity of waves returned from the ionised regions of the upper atmosphere as observed over the early morning period from about 2 a.m. until about 9 a.m. The relative intensity is taken as the ratio of the intensity of the downcoming wave to that of the ground wave. The influence on the intensity of electron-limitation and of absorption-limitation is discussed, in the light of theoretical ionisation curves given by Chapman. The experimental observations described show that the magneto-ionic doubling of the echo, which has been observed by Appleton and Builder for the F-region, occurs also for the E-region. The doublet echo for this region is observed only for a short period of the morning, owing to the fact that the extraordinary ray is very soon totally absorbed. AUTHOR.

621. Automatic Records of Radio Waves Reflected from the Ionosphere. J. A. Ratcliffe and E. L. C. White. *Phys. Soc., Proc.* 46. *pp.* 107–115, *Jan.* 1, 1933.—Some automatic records of radio waves reflected from the ionosphere are discussed. The records extend over a period of fourteen months. They indicate that the region below the F-region may be triply stratified and consist of the intermediate region (effective height approximately 120 to 180 km.), the E-region (effective height approximately 100 to 120 km.) and the *e*-region with an effective height which is always nearly 105 km., within ± 5 km. The *e*-region is shown to be intermittent in its occurrence, and is identified with the "nocturnal E-region" mentioned in previous papers. The temporal variations of the ionisation in these three regions is discussed. A statistical investigation is made to see whether the occurrence of the nocturnal ionisation in region *e* is associated with the occurrence of magnetic disturbances or of thunderstorms. It is shown that if the nocturnal ionisation were unrelated to magnetic disturbances, the probability of the observed coincidences between the occurrence of the two phenomena would be 0·01, and if thunderstorms and the nocturnal ionisation were unrelated the corresponding probability would be 0·0015. AUTHORS.

622. Ionisation Per Centimetre of Path by Individual Secondary Cosmic Rays. W. F. G. Swann. *Phys. Rev.* 44. *pp.* 961–968, *Dec.* 15, 1933. *Frank. Inst., J.* 217. *pp.* 79–86, *Jan.*, 1934.—The paper describes measurements of the ionisation caused by individual secondary cosmic rays and groups of rays in a vertical cylinder 15 cm. high and 7·5 cm. in diameter. The results are represented by plotting $F(n)$ against n, where $F(n)dn$ is the number of rays or groups passing through the cylinder in an assigned time and giving rise to spurts containing between n and $n + dn$ pairs of ions. If $f(l)dl$ is the number of rays of path length between l and $l + dl$, the theoretical curve for $f(l)$ for single rays shows a discontinuous increase at a value of l equal to the length of the cylinder, and this is followed by a sharp decrease. This phenomenon enables one to ascertain on the $F(n)$ curve the value of n which corresponds to the length of the cylinder, and so to deduce the ionisation per cm. of path in spite of the existence of multiple rays and of unavoidable amplifying tube background. The value for argon comes out as 89 ions per cm. at atmospheric pressure. This value includes the contribution cited by G. L. Locher as caused by the Auger effect. The corresponding values for nitrogen and oxygen are 61 and 57, respectively. By a further analysis of the results, and particularly of those giving simultaneous spurts of ions with two cylinders in line, the existence of multiple rays is actually verified. These rays contribute two-thirds of the total ionisation observed in the cylinder, and constitute one-third of the toal number of ionising entities, groups and singles. By a consideration of their effects it is possible to reconstruct the high values obtained for the *apparent* ionisation per centimetre of path by former observers who have deduced their values from ionisation measurements combined with counter data and from fluctuation measurements. AUTHOR.

623. Hoffman Stösse and the Origin of Cosmic-Ray Ionisation. W. F. G. Swann. *Phys. Rev.* 44. *pp.* 1025–1027, *Dec.* 15, 1933. *Frank. Inst., J.* 217. *pp.* 113–117, *Jan.*, 1934.—Calculation is made which shows that it is possible that nearly the whole of the observed cosmic-ray intensity as obtained by Geiger counters may be attributed to bursts of the Hoffman collision type in the atmosphere. F. C. C.

624. Cloud Photographs of Cosmic-Ray Stösse. G. L. Locher. *Frank. Inst., J.* 216. *pp.* 673–682, *Dec.*, 1933.—A cloud chamber 15 cm. in diameter was operated by a relay mechanism released by the discharge from 3 Geiger-Müller counters each 100 sq. cm. in cross-sectional area and placed 2 above and 1 below the chamber. The counters were arranged as non-collinearly as possible so that it was very improbable that the chamber would be operated unless at least 3 separate corpuscles passed simultaneously through the 3 counters. Surrounding the chamber was 750 lb. of Pb, 400 lb. of Cu and brass and 200 lb. of Fe. Multiple tracks were obtained which were identified with electron tracks and tracks of nuclei recoiling after being struck by neutrons. Both convergent and non-convergent groups of tracks were found. F. C. C.

See also Abstracts 461, 480, 597, 812.

RADIATION, GENERAL THEORY.

625. Eigen-Forces of Elementary Particles. Part II. G. Wentzel. *Zeits. f. Physik,* 86. 9–10. *pp.* 635–645, *Nov.* 28, 1933.—In continuation of previous work [see Abstract 178 (1934)] quantum-electrodynamic theory of limiting values of the electromagnetic field is developed in such manner that components of the eigen-forces and eigen-energies containing the electromagnetic mass vanish. J. S. G. T.

626. Density of Energy in the Theory of Light. L. de Broglie. *Comptes Rendus,* 197. *pp.* 1377–1380, *Dec.* 4, 1933.—It is shown from Dirac's wave equation, that the classical expression $(E^2+H^2)/2$ for the density of electromagnetic energy may be an approximate expression just as the expression $mv^2/2$ is an approximation for the kinetic energy in relativistic dynamics. [See Abstract 379 (1933).] J. S. G. T.

See also Abstracts 481, 811.

REFLECTION. REFRACTION AND DISPERSION.

627. Reflectivities of Sulphide Ore-Minerals. F. C. Phillips. *Min. Mag.* 23. *pp.* 458–462, *Dec.*, 1933.—Available data for 25 sulphide, selenide, and telluride minerals show that the reflectivity, R, increases with the atomic weight. Deducing from these results the molecular refractivity $[=4M\sqrt{R}/d(3-2\sqrt{R}+3R)]$ an additive relationship is shown to hold for 36 of the same or similar minerals. The additive values thus deduced are comparable with those deduced for anion and kation from transparent ionic substances, *e.g.* compounds of S, Se, and Te. They also enable densities to be checked, and several errors have thus been detected; a critical list of densities is given. C. A. S.

628. Classical Optics. Part I. E. Buchwald. *Die Physik,* 1. 4. *pp.* 179–192, 1933.—A review is given of a number of outstanding optical phenomena, including X-ray experiments. W. D. W.

629. Optical Imagery by Mechanical Systems and the Optics of Non-Homogeneous Isotropic Media. W. Glaser. *Ann. d. Physik,* 18. 5. *pp.* 557–586, *Nov.*, 1933.—Starting from Hamilton's mechanical-optical analogy and using variational methods the general theory of the ray paths for particles moving in a rotation symmetric electromagnetic field, is developed. The variation of mass with velocity is allowed for. The analysis also represents the geometrical optics of inhomogeneous media with continuously variable refractive index. The first approximation, applicable when all rays remain near the axis, is studied and conditions for stigmatic image formation are derived, together with an expression for the rotation of the image with respect to the object. The theory of higher approximations is also dealt with, generalisations of the Seidel formulæ and Petzval's theorem being obtained. The analysis covers the theory of the electron microscope as a special case. W. S. S.

630. Refraction and Refractive Indices of Dilute Solutions. Part II. Thallium Chloride and Thallium Nitrate. A. E. Brodsky and N. S. Filippowa. *Zeits. f. phys. Chem.* 23. *Abt.B.* 5–6. *pp.* 399–411, *Dec.*, 1933.—A description is given of improvements in the interferometer method [see Abstract 86 (1932)] of obtaining refractive indices of dilute solutions, in order that the accuracy may be increased and error in the determination of the null-point removed. Refractive indices, dispersive power and temperature coefficients are found for 0·001 to 0·1 *N* solutions of TlCl and $TlNO_3$. In the region measured, the ratio of the difference of the refractive index Δn between the solution and water to the concentration C varies linearly with C. This method is shown to be useful for salts which are only with difficulty soluble. [See following Abstract.] H. M. B.

631. Refraction and Refractive Indices of Dilute Solutions. Part III. Potassium Chloride, Potassium Bromide, Sodium Chloride and Sodium Nitrate. A. E. Brodsky and J. M. Scherschewer. *Zeits. f. phys. Chem.* 23. *Abt.B.* 5–6. *pp.* 412–427, *Dec.*, 1933.—By the interferometer method [see preceding Abstract] the refractive indices of 0·001 to 0·1 *N* solutions of the four salts are found at temperatures 18° to 25° C. under atmospheric conditions at different times of the year. The quotient $\Delta n/C$ decreases linearly with increasing concentration for all the salts except NaCl. The refraction *R* per gm. molecule is calculated, and it is found that the relation of this with concentration is non-linear, in contrast to concentrated solutions. The results agree with the theory of Debye and Hückel for strong electrolytes and the end values for complete dissociation are discussed. [See following Abstract]. H. M. B.

632. Relation between Concentration and Molecular Refraction of Electrolytes. K. Fajans and W. Geffcken. *Zeits. f. phys. Chem.* 23. *Abt.B.* 5–6. *pp.* 428–430, *Dec.*, 1933.—Comparing results of Brodsky and Scherschewer [see preceding Abstract] with those of Geffcken and Kruis on NaCl solution, it is maintained that some systematic error must be present in the relation between refractive index and concentration. This is unlikely in the results of Geffcken and Kruis, since they were checked by other methods. Sources of error, such as the formation of association products, are discussed. H. M. B.

633. Self-Illuminating Magnifying Lens. G. Jäckel. *Zeits. f. techn. Physik,* 14. 11. *pp.* 499–500, 1933.—For simple magnification the illumination of the object has not hitherto been considered, but only methods of obtaining undistorted images. Using the lens itself as a condenser, great improvement in lighting is obtained when the refracting surface is a hemispherical cap, forming the end of a cylinder. Illustrations of the arrangement and photographs of printing using the lens, show the method and results. H. M. B.

634. Luminous Quartz Fluorite Achromatic Lens. A. C. S. van Heel. *Physica,* 1. *pp.* 35–40, *Dec.*, 1933.—The various conditions which must be fulfilled by a lens system for use with a quartz monochromator are discussed. A lens system based on this discussion is calculated and gives satisfactory results. A. H.

635. Optical Apparatus with Wide Field Using Interference of Polarised Light. B. Lyot. *Comptes Rendus*, 197. *pp*. 1593–1595, *Dec*. 18, 1933.—A description is given of an apparatus by means of which it is possible to observe, without much loss of light, the different points of an illuminated surface simultaneously, by using a small region of its spectrum. The instrument has great advantages, for solar observations, over other types of apparatus. In particular, it allows of photographs of the corona being taken when there is no eclipse. G. C. McV.

See also Abstracts 435, 445, 523, 585, 610, 614, 732, 780.

SPECTROSCOPY.

636. Arc Spectrum of Silicon in the Red and Infra-Red. C. C. Kiess. *Bureau of Standards, J. of Research*, 11. *pp*. 775–782, *Dec*., 1933.—No accurate description of the red and infra-red portion of the arc spectrum of silicon has been published in the 40 years that have elapsed since Rowland's work which terminated at 5948 Å. In this paper, wave-lengths are given for 130 new lines between 6125 and 11290 Å, many of which are present in the solar spectrum, including the strongest hitherto unidentified Fraunhofer line. More than 50 % of these lines have been classified as combinations between new terms and terms already established for Si I. The new terms arise from the electron configurations containing the 4*p*, 4*f*, and 5*f* electrons. AUTHOR.

637. Arc Spectrum of Rhenium. Part IV. H. Schober. *Akad. Wiss. Wien, Ber*. 142. 2*a*. 1–2. *pp*. 35–69, 1933.—In continuation of previous work [see Abstracts 1223 (1932) and 2404 (1933)], the ultra-violet spectrum between 4800 Å and 2400 Å as excited on copper electrodes has been photographed with a 15 ft. concave grating. More than 1800 lines have been measured with an accuracy of ± 0·02 Å, the maximum emission being near 3400 Å. The complete arc spectrum between 2400 Å and 8000 Å contains about 3000 lines. F. S.

638. Line Absorption of Sodium Vapour at the Two D-Lines. W. Zehden. *Zeits. f. Physik*, 86. 9–10. *pp*. 555–582, *Nov*. 28, 1933.—An experimental arrangement is described, by means of which the line absorption of the D_1 and D_2 lines of sodium can be measured separately over a range of pressures from 1×10^{-6} to 4×10^{-5} mm. Hg, to an accuracy of 4 %. From the results, the values $f_{D1} = 0 \cdot 267$, $f_{D2} = 0 \cdot 532$ are calculated. These agree qualitatively with the values obtained from measurements of magnetic rotation, when account is taken of hyperfinestructure. On the basis of the magnetic rotation values and the hyperfinestructure values given by Schüler, values of the line absorption at various pressures and for various column lengths are calculated. Values $\frac{1}{2}$ and $\frac{3}{2}$ are obtained for the nuclear spin. The measured absorption is systematically higher than that calculated. This cannot be explained by taking account of secondary resonance, but the difference may be due to error introduced in extrapolation from the vapour pressure formula. C. B. A.

639. Low-Voltage Arc in Sodium. M. J. Druyvesteyn. *Physica*, 1. *pp*. 14–27, *Dec*., 1933. *In German*.—The absorption of a sodium-vapour lamp for the D-lines was measured by a modification of the method of inversion temperature. The inversion is measured by comparison of the resonance lines with temperature-radiation of a very hot body, an absorption vessel being placed in front of the spectroscope. The number of Na atoms in the $2p$-state is approximately 12 % of those in the normal state, while the number of Na^+ ions is from 2 to 5 times that of the Na atoms. F. S.

640. Absorption by Excitation of Inner Electrons. Part I. General. H. Beutler. *Zeits. f. Physik*, 86. 7–8. *pp*. 495–515, *Nov*. 15, 1933. —Experimental details for the observation of the line absorption spectra of atomic gases (metallic vapours) in the region 1200–600 Å are given. The spectra are attributed to the removal of an electron from the first closed shell below the valency electron, this remaining meanwhile in its quantum orbit. Excited terms beyond the ionisation limits may divide spontaneously into an ion and an electron (autoionisation), and selection rules for this process are given. The new terms can be arranged in systems whose limits are excited terms of the spark spectra. Their values can be determined by comparison with those corresponding to the arc spectra of the elements following in the periodic table. [See following Abstract.] C. B. A.

641. Absorption by Excitation of Inner Electrons. Part II. Hg Spectrum between 1190 and 600 Å under Excitation of the $(5d)^{10}$ Level. (Hg I^b). H. Beutler. *Zeits. f. Physik*, 86. 11–12. *pp*. 710–728, *Dec*. 7, 1933.—The absorption series in Hg vapour lying on the short wave-length side of the ionisation limit (1188 Å) are recorded against the continuous spectra of He and A by a method previously described [see preceding Abstract]. Nearly all the lines may be included in Rydberg series which converge to the terms $(5d)^9\ (6s)^2\ {}^2D_{5/2,\,3/2}$ of $Hg.^+$. The lines are attributed to transitions $(5d)^{10}(6s)^2\ {}^1S_0 \rightarrow (5d)^9(6s)^2mp\,{}^1P_1$, ${}^3P_1$ or ${}^3D_1$, or to $\rightarrow (5d)^9(6s)^2mf\,{}^1P_1$ or ${}^3P_1$. This spectrum is denoted by Hg I^b, and corresponds in X-ray nomenclature to the excitation of the O_3 level. The analysis is carried out on the basis of the Hund theory, and the mp terms are separated from the mf terms. The lowest term $(5d)^9(6s)^26p\,{}^1P_1$ lies below the normal series limit in the discrete spectrum. This series $m\,{}^1P_1$ converges to $Hg^+\ {}^2D_{5/2}$; its terms immediately above the normal limit are diffuse (autoionisation), the higher ones become sharper. The series $m\,{}^3P_1$ lies entirely above the normal limit, the lowest terms being diffuse. Close to each of its members lies a $m\,{}^3D_1$ term which is sharp; both series converge to ${}^2D_{3/2}$ of Hg^+. Two series arise from $(5d)^9(6s)^2mf$, converging respectively to ${}^2D_{5/2}$ and ${}^2D_{3/2}$. The energies of excitation of the strongest absorption lines do not agree with the ultra-ionisation potentials found in this region. [See following Abstract.] C. B. A.

642. Absorption by Excitation of Inner Electrons. Part III. Cd Spectrum between 1100 and 600 Å under Excitation of the $(4d)^{10}$ Level. (Cd I^b.) H. Beutler. *Zeits. f. Physik*, 87. 1–2. *pp*. 19–27, *Dec*. 13, 1933.—About 30 absorption lines in Cd vapour lying beyond the limit of the arc spectrum (1376 Å) have been photographed against the continuous spectra of He and H_2. The upper terms can all be arranged in Rydberg series whose limiting terms are $(4d)^9(5s)^2$, ${}^2D_{3/2}$ and ${}^2D_{5/2}$ of Cd^+. The lines are attributed to transitions $(4d)^{10}(5s)^2\ {}^1S_0 \rightarrow (4d)^9(5s)^2mp\,{}^1P_1$, ${}^3P_1$ or ${}^3D_1$, or to $\rightarrow (4d)^9(5s)^2mf\,{}^1P_1$ or ${}^3P_1$. The spectrum is denoted by Cd I^b and in X-ray nomenclature is the N_3 absorption. . The terms agree with the corresponding ones of the arc spectrum of In. The lowest terms of the series $mp\ {}^1P_1$ and ${}^3P_1$ are diffuse to an extent which increases the

closer their energies are to the series limit of Cd I, and they become sharper as they recede from this limit. Close above the $mp\ ^3P_1$ terms lie sharp $mp\ ^3D^0{}_1$ terms; these two series converge to $^2D_{3/2}$ $(4d)^9(5s)^2$ of Cd⁺, $m\ ^1P_1$ to the lower term $^2D_{5/2}$. Relatively sharp series, converging to the same limits, are observed from $(4d)^9(5s)^2$ *mf*. [See preceding Abstract.]
C. B. A.

643. Measurement of the Light Emission in the Argon-Mercury Spectrum by Electronic Impacts. O. Fischer. *Zeits. f. Physik*, 86. 9–10. *pp.* 646–666, *Nov.* 28, 1933.—The excitation functions of the violet group of lines in the arc spectrum of argon and of a number of blue lines in the argon spark spectrum are measured. The results confirm previous work by other workers. The absolute values of the emission due to the argon lines and the mercury line $\lambda = 4358$ excited by electrons of energy corresponding to 60 volts are determined.
J. S. G. T.

644. Applications to Atomic and Molecular Theory of Spectral Intensity Measurements. L. S. Ornstein. *J. de Physique et le Radium*, 4. *pp.* 613–624, *Nov.*, 1933.—This paper is a general survey of the subject, theories indicating the method of application of photographic photometry of spectral lines being outlined. Particular subjects dealt with comprise the probabilities of emission, of activation and of excitation of atoms by electronic collisions; the laws of intensity in complicated cases and in band spectra; the application to the kinetic theory of gases, in particular the determination of the coefficient of accommodation; and the theory of the electric arc.
D. H. F.

645. Natural Width of Lines in Visible Ne Spectrum. Part I. W. Schütz. *Ann. d. Physik*, 18. 7. *pp.* 705–720, *Dec.*, 1933.—From the derivation by Weisskopf and Wigner, on the basis of Dirac's theory, of the width of spectral lines, it is shown how the widths depend upon the life-periods of the various excited energy states involved. It follows that only certain lines are suitable for putting the theory to the test; the positive column of the neon discharge affords a suitable source, using lines in the visible. The experimental results obtained show that the widths of the lines tested fall in the right order, as predicted by the theory, although numerical results could not be obtained. [See following Abstract.]
D. H. F.

646. Natural Width of Lines in Visible Ne Spectrum. Part II. H. Schillbach. *Ann. d. Physik*, 18. 7. *pp.* 721–745, *Dec.*, 1933.—This paper describes an attempt to test quantitatively the theory put forward in the first part [see preceding Abstract]. If the radiation from the positive column of the neon discharge has to traverse a long path through the excited neon the lines are so broadened under the action of the electrons associated with them that the width can be measured. In a neon tube in which the thickness of the excited gas was sufficiently large the density of the electrons concerned in the broadening was measured by determining the magneto-rotational effect on a beam of polarised light passed through the excited Ne; the intensity distribution over the width of the Ne lines was determined using a Fabry-Perot interferometer. The results obtained agree with the theory. Results are also given for the relation between the intensities of the lines in the two cases where the thicknesses of the excited layers are in the ratio 2 : 1, and also for the dependence of the intensities on the current in the gas. [See following Abstract.] D. H. F.

647. Dependence on Current Strength of Intensities of Visible Neon Lines from the Positive Column. W. Schütz. *Ann. d. Physik,* 18. 7. *pp.* 746–754, *Dec.,* 1933.—This paper is a theoretical discussion of the experimental results published in another paper [see preceding Abstract]. D. H. F.

648. Displacement and Unsymmetrical Broadening of Absorption Lines in the Presence of Foreign Gases. C. Füchtbauer and F. Gössler. *Zeits. f. Physik,* 87. 1–2. *pp.* 89–104, *Dec.* 13, 1933.—Absorption curves are obtained for the second and third doublets in the principal series of Cs in the presence of He, Ne, A, N_2 and H_2 respectively. The resulting displacements, half-widths, and dissymmetry are determined, and the last two features are also recorded for K in the presence of H_2 and of N_2. Displacements towards the violet are observed as well as towards the red, and the displacement is proportional to the density. It increases with the number of the member in the series in the presence of the noble gases, but decreases in N_2. In N_2 and Ne, the dissymmetry alternates from the red side (for 4555 Å) to the violet (for 3876 Å). The broadening is greater for Cs than for the corresponding line for K, and increases towards the higher members of the series. The effectiveness of the gases in broadening the lines decreases in the order H_2, He, A,N_2, Ne for all the lines so far observed (Cs, K, Na, Hg). The two doublet lines have in general the same half-widths, an exception being the broadening by H_2 in the cases of K and Cs. C. B. A.

649. Asymmetries of Pressure Broadened Spectral Lines. H. Margenau. *Phys. Rev.* 44. *pp.* 931–934, *Dec.* 1, 1933.—Experiments have disclosed peculiar asymmetries in the intensity distribution of pressure broadened lines. The present paper is devoted to their explanation. The simple case of a one-dimensional gas is considered and an expression for the line contour developed. By graphical methods the line contours have been calculated corresponding to three typical interaction curves. The conclusion is that, by taking proper account of the repulsive portions of the energy curves, the empirically found asymmetries can be reproduced. [See Abstract 197 (1934).] AUTHOR.

650. Intensities of Atomic Spectral Lines from a Hydrogen Discharge-Tube. W. W. Jackson. *Phil. Mag.* 17. *pp.* 33–53, *Jan.,* 1934.—The apparatus allows a continuous stream of pure hydrogen to pass through the discharge-tube, and conditions were obtained whereby the atomic spectrum of hydrogen was produced free from background. The variations in the intensities of the lines H_α and H_β in the Balmer series, and of P_α in the Paschen series of the atomic spectrum of hydrogen have been measured as the discharge current through the tube varied from 200 mA. to about 800 mA., the pressure in the tube and the potential fall across the tube remaining constant. The intensities of the lines have been measured directly, using a vacuum thermoelement connected to a sensitive galvanometer, and it has been found that the curve connecting the intensity of H_α with the discharge current is parabolic, whilst the variations of both H_β and P_α are linear. The ratio of the intensities of H_α and H_β increases linearly with the current; thus, different experimental values of this ratio obtained by different workers are reconciled. By the comparison of the intensities of H_β and P_α, relative values of transition probabilities have been experimentally determined, and the value obtained is in fair agreement with the values quoted by Slack. AUTHOR.

651. Nuclear Spin and Magnetic Moment of Sodium from Hyperfine Structure. L. P. Granath and C. M. van Atta. *Phys. Rev.* 44. *pp.* 935–942, *Dec.* 1, 1933.—The hyperfine structure of the sodium *D* lines from a liquid-air cooled Schüler tube was observed with a Fabry-Perot interferometer. Each line has two resolvable components; the separations are: for D_2 (λ5890), $0 \cdot 055$ cm^{-1}, for D_1 (λ5896), $0 \cdot 0612$ cm^{-1}. The total h.f.s. splitting for the $3\,{}^2S_{\frac{1}{2}}$ state is $0 \cdot 0583$ cm^{-1}., for the $3\,{}^2P_{\frac{3}{2}}$ state $0 \cdot 0050$ cm^{-1}. and for $3\,{}^2P_{\frac{1}{2}}$ $0 \cdot 0083$ cm^{-1}. Relative intensity measurements are consistent with a nuclear spin of $\frac{3}{2}$. The nuclear magnetic moment is calculated at $2 \cdot 7/1840$ Bohr magnetons. AUTHORS.

652. Multiplet and Hyperfine Structure Analyses of Bi IV. Discussion of Perturbation Effects. A. B. McLay and M. F. Crawford. *Phys. Rev.* 44. *pp.* 986–996, *Dec.* 15, 1933.—Three hundred and sixty lines of Bi IV, excited in an electrodeless discharge, have been classified. Twenty-seven terms of $6snx$ configurations, four terms of $6p^2$ and six terms of $5d^9\,6s^2\,6p$ have been identified. Evidence of perturbation of $6s5f$ and $6s7p$ by $5d^9\,6s^2\,6p$ and of $6s6d$ by $6p^2$ is presented. The perturbation of $6s6d$ by $6p^2$ in Bi IV and other members of the Hg I sequence is shown to agree qualitatively with Bacher's theory of $sd-p^2$ interactions. The hyperfine structure intervals of many of the terms of Bi IV have been evaluated. They are compared with the theoretical formulæ for hyperfine structure separations and shown to be consistent with our multiplet analysis. Anomalous hyperfine structure has been observed in $6s7p_{\frac{1}{2}}$. This is interpreted as a coupling effect due to the approximate equality of the multiplet and hyperfine structure separations of $6s7p_{\frac{1}{2}}$. Goudsmit and Bacher's theory of hyperfine structure perturbations due to a change in coupling is applied to the four hyperfine levels of $6s7p_{\frac{1}{2}}$. Their theory accounts for the observed distribution of these levels and for the appearance of forbidden transitions. AUTHORS.

653. Hyperfine Structure Absorption in Optically Excited Mercury Vapour. M. L. Pool and S. J. Simmons. *Phys. Rev.* 44. *pp.* 997–1001, *Dec.* 15, 1933.—The radiation 4047, 2967 and 2752, all terminating on the 2^3P_0 state of mercury, was passed through optically excited mercury vapour and the absorption of each wave-length for various lengths of excited vapour and for various pressures of admixed nitrogen was measured photometrically. With low dispersion the intensity of 2752 decreased nearly exponentially with increase in length of excited vapour giving a constant linear absorption coefficient. But the lines 4047 and 2967 were found not to obey the exponential law, the fractional decrease in intensity per unit length of path decreased rapidly as the total length of the absorbing vapour increased. With high dispersion the absorption of the five components of 4047 was strong and increased with increase of admixed nitrogen. The strongest component showed the strongest absorption and the amount of absorption decreased with decrease in intensity of components. The intensity of each component decreased nearly exponentially with increase in length of excited mercury vapour. Both components of 2967 showed strong absorption. None of the components of 4358 or 5461 showed measurable absorption. AUTHORS.

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19

654. Mechanical Moment of the Nucleus of Cæsium. D. A. Jackson. *Roy. Soc., Proc.* 143. *pp.* 455–464, *Jan.* 1, 1934.—The hyperfine structure doublets of the cæsium lines λ4555 ($6S_{\frac{1}{2}}-7^2P_{\frac{3}{2}}$) and λ4593 ($6S_{\frac{1}{2}}-7^2P_{\frac{1}{2}}$) are examined with a high quality ghost-free glass Lummer-Gehrcke plate. Extremely careful and accurate methods are applied to the measurement of the relative intensities of the hyperfine structure components of the lines. By working at very low vapour pressures of cæsium the effect of self-absorption could be almost completely eliminated and a correction for the remaining absorption could be made by measuring the intensities at a few known tube temperatures. The mean of a large number of independent measurements of the intensity ratio of the components of each line gave a value 1·27 : 1·00 with a probable error of 2 %. This value is in good agreement with the value 1·28 : 1·00 required by theory for a nuclear moment $I=7/2$; this value of the nuclear moment can now be regarded as established with certainty. J. E. K.

655. Excitation of Atoms in Inner Shells by Slow Protons and α-Particles. W. Henneberg. *Zeits. f. Physik,* 86. 9–10. *pp.* 592–604, *Nov.* 28, 1933.—According to certain authors the Born method of treating collision processes should be valid only when the velocity of the incident particle is large compared with the orbital velocity of the electron with which it collides. This condition is not fulfilled in the case of α-particles and K-electrons, but it is nevertheless shown that the ionisation probability of the K-shell by slow protons or α-particles can be calculated by Born's method. In agreement with experiments the probability of ionisation is found to increase more rapidly than in direct proportion to the increase of energy of the particles. For small energies the probability is proportional to the fourth power of the energy of the incident particle. J. E. K.

656. Infra-Red Bands and Molecular Constants of HBr. E. K. Plyler and E. F. Barker. *Phys. Rev.* 44. *pp.* 984–985, *Dec.* 15, 1933.—The fundamental band of HBr has been remeasured, and the harmonic band examined for the first time under high resolution. From the equations representing line positions the values $\nu_0=2649\cdot74$ cm^{-1}., $I_0=3\cdot2634\times10^{-44}$ gm. cm^2., and $r_0=1\cdot4096\times10^{-8}$ cm. are obtained. Resolution of the isotopic components was just possible in the fundamental band, and the observed separations agree with those computed from the isotopic masses of Br. AUTHORS.

657. Ultra-Violet Absorption of Aldehydes. H. Conrad-Billroth. *Zeits. f. phys. Chem.* 23. *Abt.B.* 3–4. *pp.* 315–318, *Nov.,* 1933.—The ultra-violet absorption spectra of acet-, propionic, n- and i-butyric, n- and i-valeric, capronic, n-heptyl, n-octyl, n-nonyl, methylethylacet- and trimethylacetaldehydes in hexane solution are recorded. The frequencies of the absorption maxima are compared with those of the corresponding methyl ketones. For the normal derivatives, the separation is almost exactly constant and equal to 1350 cm^{-1}., but deviations from this value are observed in the compounds with branched chains. C. B. A.

658. Absorption of Light by p-Nitrosodimethylaniline. J. F. H. Custers and C. J. Dippel. *Zeits. f. Physik,* 86. 7–8. *pp.* 516–520, *Nov.* 15, 1933.—The absorption spectrum of $p\text{-NO}\cdot C_6H_4\cdot N(CH_3)_2$ in aqueous solution contains a very intense maximum of absorption at about 4310 Å, and a less intense maximum at 2750 Å. Neutralisation by an equivalent amount of HCl reduces the intensity at 4310 Å, but introduces a new maximum, slightly more intense, at 3500 Å, the absorption below 2860 Å being at the same time diminished. The neutral solutions are found to be less stable, and data are recorded with reference to the use of the compound in light filters. C. B. A.

659. Absorption of I_2 Vapour in Presence of Foreign Gases. I. I. Agarbiceanu. *Comptes Rendus,* 197. *pp.* 1198–1199, *Nov.* 20, 1933. —The increased absorption of I_2 vapour in the presence of foreign gases previously noted [see Abstracts 566 and 1431 (1933)] has been further studied, with O_2 and N_2 as foreign gases. It was found that existing absorption bands are strengthened, but no new bands appear, oxygen being slightly more active than nitrogen. A deactivation of the excited I_2 molecules during collision with foreign molecules is indicated. The fluorescence spectrum excited by Hg 5461 was studied with an échelon spectrograph. The structure of the rotation doublets was generally identical with that of the corresponding absorption bands. It is not possible to explain the anti-Stokes rays in the resonance spectrum of I_2 in this way. W. R. A.

660. Combinational Relations in the Absorption Spectrum of Liquid Oxygen. J. W. Ellis and H. O. Kneser. *Zeits. f. Physik,* 86. 9–10. *pp.* 583–591, *Nov.* 28, 1933.—The absorption spectrum of liquid oxygen is investigated in the region 340 to 2750 $m\mu$. A new band is discovered at 1261 $m\mu$ ($\nu_1 = 793 \cdot 0$ mm.$^{-1}$) and identified as the O – O band of the $^3\Sigma - {}^1\Delta$ system. The O – O band of the $^3\Sigma - {}^1\Sigma$ system ("atmospheric bands") lies at $\nu_2 = 1307 \cdot 2$ mm.$^{-1}$. With the exception of one weak group the complete absorption spectrum in the visible and infra-red spectrum can be represented by: $m\nu_1 + n\nu_2 + vw$ (m and $n = 0, 1, 2$; $m + n \leqq 2$; $v = 0, 1, 2, 3 \ldots.$) where w is the vibration quantum of the O_2 molecule. The combination bands ($m + n > 1$) are ascribed to absorption by $(O_2)_2$ molecules. The concentration of the $(O_2)_2$ molecules is estimated from the intensity, and their energy of dissociation from the gradation of the bands, and found to be in agreement with G. N. Lewis' estimate. J. E. K.

661. Absorption Spectra of Diphenols in Alkaline Solution. A. Saint-Maxen and E. Dureuil. *Comptes Rendus,* 197. *pp.* 1411–1413, *Dec.* 4, 1933.—The absorption spectra of hydroquinone, pyrocatechin, and resorcin in aqueous solution with and without alkali have been measured (no curves given). The spectrum of hydroquinone is modified by the addition of alkali and becomes similar to that of quinone. The modification does not depend on the alkali used, and only occurs in diphenols capable of assuming a quinone structure. It is marked in pyrocatechin and hydroquinone, negligible in resorcin. This is in accordance with the existence of a substance of quinone structure in alkaline solutions of hydroquinone. C. B. A.

662. Absorption Spectra of Water Vapour and of Carbon Dioxide below 2000 Å. G. Rathenau. *Zeits. f. Physik,* 87. 1–2. *pp.* 32–56, *Dec.* 13, 1933.—A method of producing a continuous spectrum which allows of observations of discrete absorption between 2200 and 270 Å is described, and the absorption spectra of water vapour and of carbon dioxide over this range are investigated. Water vapour shows, below 1780 Å, continuous absorption and predissociation bands, and a second continuum, also with predissociation, occurs at 1340 Å. Above 10 volts, a further series of low intensity is found, and this is followed by sharp bands. The continua setting in at 10 volts and at 16 volts, also found by Henning, are measured, and new continua are observed at 17·8 and at 24·5 volts. In CO_2, at the relatively low pressures employed, absorption first sets in at 10 volts. Three vibration series are identified, and several bands are arranged in two other series. Henning's results between 900 and 600 Å are confirmed, several new bands being fitted into his series. Three continua in this region are measured, and continuous absorption is also found at 600 Å. These results are discussed and, in part, interpreted. C. B. A.

663. Structure of the Ultra-Violet Absorption Spectrum of Formaldehyde. Part I. G. H. Dieke and G. B. Kistiakowsky. *Phys. Rev.* **45.** *pp.* **4–28,** *Jan.* **1, 1934.**—The ultra-violet absorption spectrum of formaldehyde was photographed under high dispersion so that the rotational structure could be analysed. The present paper gives details of six bands at 3530, 3430, 3390, 3370, 3295 and 3260 Å. The bands are due to transitions in which the electric moment is in the plane of the molecule and perpendicular to the CO-axis. As the asymmetry of the molecule is very slight, the structure of the bands is very nearly the structure of vertical bands due to a symmetrical top. The position and intensity of the lines is in very good agreement with this except if the component K of the angular momentum along the CO-axis is smaller than four. In this case, the effect of the asymmetry makes itself felt in a shift and doubling of the lines in agreement with the theoretical expectations. A rigorous check of all the regularities is furnished by combination relations. The distortion of the molecule by the rotation can be studied in the deviations of the observed energy values from those of a rigid top. A value for the force between the two C — H bonds results from this. In the bands 3430 and 3295 there are strong perturbations which affect the dependence of the rotational energy on the quantum number K only, not that on the total angular momentum J. The molecular constants for the normal state of the molecule and six vibrational states of the excited electronic level can be obtained with good accuracy. AUTHORS.

664. Structure of the Second Positive Nitrogen Group. A. Guntsch. *Zeits. f. Physik,* **86. 3–4.** *pp.* **262–273,** *Oct.* **31, 1933.**—Gives an analysis of 18 bands of the second positive nitrogen group based on new measurements, partly overlapping similar work by Coster, Brons and van der Ziel [see Abstract 4516 (1933)]. Tables of term values and the rotation constants of the respective states terminating with final state 8, are given. Q branches were found in three bands, in accordance with theory. Anomalies in the initial state 1 were noted. W. S. S.

665. Analysis of N_2^+ Bands. A. E. Parker. *Phys. Rev.* **44.** *pp.* **914–918,** *Dec.* **1, 1933.**—The $\Delta v = 3$ sequence of the $^2\Sigma - {}^2\Sigma$ N_2^+ bands have been photographed in the second and third orders of a 21 ft. grating. Rotational analyses have been made of the (4,7,) (5,8) (6,9) and (7,10) bands. The B values obtained fit the expressions previously given for B_v' and B_v'' quite well [see Abstract 4105 (1933)]. The perturbation in the (5,8) band has been investigated. The present data on the perturbing $^2\Pi$ state are discussed. Additional measurements in the (13,15) band are also given. AUTHOR.

666. Nuclear Spin of Phosphorus from Band Spectrum Analysis. Muriel F. Ashley. *Phys. Rev.* **44.** *pp.* 919–926, *Dec.* 1, 1933.—The emission spectrum of P_2 has been photographed in the first and second orders of the 21 ft. grating. A strong alternation in intensity is observed in the successive rotational lines of many bands. The intensity ratio is found to be 3 : 1, hence the nuclear spin of phosphorus is $\frac{1}{2}(h/2\pi)$. A fine structure analysis was made of the (6,22), (6,23), in addition to the (8,27), (8,28) and (9,28) bands previously reported by Herzberg. Only *P* and *R* branches are present. The transition involved is $^1\Sigma \rightarrow {}^1\Sigma$. The levels of the ground state have the greater statistical weight. The following molecular constants are obtained: $Be' = 0{\cdot}2415$ cm^{-1}. ; $Be'' = 0{\cdot}3058$ cm^{-1}. ; $\alpha' = 0{\cdot}00164$; $\alpha'' = 0{\cdot}00165$. AUTHOR.

667. Bands in the Electronic Band Spectrum of Neutral OH. Katherine Chamberlain and H. B. Cutter. *Phys. Rev.* **44.** *pp.* 927–930, *Dec.* 1, 1933.—By producing a very rapid flow of water vapour through a discharge tube and h.f. excitation, it was possible to bring out portions of two new bands in the spectrum of neutral OH. These have been identified as the (3,0) and (3,1) bands. Faint lines have also been found between the lines of the $^{RR}R_{21}$ singlet series of the λ3064 band. These lie where approximate calculations indicate that the $^{RR}\mathrm{R}_{21}$ branch of the (0,0) band of the isotope OH^2 should fall. The singlet series $^{RR}R_{21}$ of the (2,0) band reported by Almy and Rahrer appears on our plates. There is also a group of nine lines extending from λ2539 to λ2565. This may be a portion of the (4,1) band but it has not been found possible to establish this definitely. AUTHORS.

668. Harmonic and Combination Bands in CO_2. E. F. Barker and Ta-You Wu. *Phys. Rev.* **45.** *pp.* 1–3, *Jan.* 1, 1934.—The absorption bands of CO_2 at higher frequencies are important for the determination of anharmonic constants which characterise the potential function and for the location of upper levels in the vibration diagram of ν_1 and ν_2 in which resonance interaction appears. Only the odd harmonics are active. The band $3\nu_2$ at $5{\cdot}0\mu$ has been measured under high resolution and five zero branches identified, two originating in the normal state and three in the first excited state. The rotational structure of the strongest of these bands at 2078 cm^{-1}. is resolved. The band $3\nu_3$ at $1{\cdot}43\mu$ is a typical doublet. Combination bands near 2μ and $1{\cdot}6\mu$ are sufficiently resolved to show their contours and to permit for the first time a satisfactory determination of their positions. AUTHORS.

669. Vibrational Isotope Effects in Three-Particle Systems. Part I. A. Adel. *Phys. Rev.* **45.** *pp.* 56–58, *Jan.* 1, 1934.—Proceeding on the assumption of valence forces between the units of a general three-particle system, an analysis is made of the effects of isotopy on the three fundamental frequencies of oscillation. In conformity with Salant and Rosenthal, the effects are classified as end and central isotope effects. The quantities $\Delta\omega_1/\omega_1$, $\Delta\omega_2/\omega_2$ and $\Delta\omega_3/\omega_3$ are derived for both cases. It is demonstrated that the analysis provides a criterion for deciding between several hypothetical models of a single molecule. AUTHOR.

670. Continuous Absorption Spectrum of Polyatomic Molecules. Part III. Y. Hukumoto. *Tohoku Univ., Sci. Reports,* **22.** *pp.* 868–878, *Oct.,* 1933. *In English.*—The following alkyl halides have been examined in the gaseous state, C_2Cl_4 ; C_2HCl_3 ; C_2H_5Cl ; *sec*-C_4H_9Cl ; *sec*-C_4H_9Br ;

sec-C_4H_9I. Tetrachlorides of C, Si, Ti and Sn have been investigated in both liquid and gaseous states and the mechanism of the photodissociation in considered to be $XCl_4 + h\nu = XCl_3 + Cl^*$. It is found that the absorption limit for the liquid is nearer the red than for the gas. [See Abstract 3035 (1933).] W. R. A.

671. Absorption Spectra of Sulphides of Zn, Cd and Hg. P. K. Sen-Gupta. *Roy. Soc., Proc.* 143. *pp.* 438–454, *Jan.* 1, 1934.—The absorption spectra of the sulphides of Zn, Cd, and Hg have been studied in the region λ 7000 to λ 1900. The vapours of these substances absorb light continuously from a long wave limit resulting in photochemical dissociation into two normal atoms, in accordance with the following photochemical equation: $MS + h\nu_1 = M + S\ (^3P)$. After the first absorption there is a retransmitted patch and a second absorption corresponding to $MS + h\nu_2 = M + S\ (^1D_2)$. For HgS there is another retransmitted patch of light with a third absorption corresponding to $MS + h\nu_3 = M + S\ (^1S_0)$. The differences $h\nu_1 - h\nu_2 = 1{\cdot}3$ volts and $h\nu_2 - h\nu_3 = 1{\cdot}51$ volts are attributed to the values of $^3P - {}^1D_2$ and $^1D_2 - {}^1S_0$ of sulphur respectively. It is postulated that the compound MS is ionic in nature, of the type $M^{++}S^{--}$ in the gaseous state. With the passage of light both the electrons from S^{--} are simultaneously transferred to M^{++} giving two normal atoms, the linkage being broken. The possibility of the formation of Zn^+S^- out of the transition of a single electron from S^{--} to Zn^{++} in $Zn^{++}S^{--}$ has been discussed. Heat of dissociation of S_2 into S atoms has been indirectly determined to be 102·9 k. cal.

AUTHOR.

672. Continuous Absorption of Light in Caesium Vapour. H. J. J. Braddick and R. W. Ditchburn. *Roy. Soc., Proc.* 143. *pp.* 472–481, *Jan.* 1, 1934.—The absorption of light in caesium vapour is measured from the series limit (λ 3184) to λ 1935. The absorption at all wave-lengths is directly proportional to the pressure. The absorption decreases from the limit to λ 2750 and then rises monotonically to the lowest wave-length observed. The value of the atomic absorption coefficient at the limit is $2{\cdot}2 \pm 0{\cdot}1\ cm^{-1}$. This agrees with the value deduced by Mohler and Boeckner from measurements of the photoionisation. Thus the whole of the absorption appears to be photoelectric. Special experiments showed that the absorption in the farther ultra-violet was proportional to the vapour pressure of caesium. The rise thus appears to be of atomic origin. No appreciable part of the absorption is due to adsorbed films of caesium on the windows. AUTHORS.

673. Zeeman Resolution of Infra-Red Lines of the Krypton Spectrum (KrI). B. Pogány. *Zeits. f. Physik,* 86. 11–12. *pp.* 729–738, *Dec.* 7, 1933.—The Zeeman resolutions of the infra-red lines of the krypton arc spectrum are measured, using a Lummer plate and field strengths from 3000 to 14000 gauss. Since the times of exposure amount to several days, precautions are taken to ensure constancy of the temperature of the apparatus. The results are used to calculate *g*-values, and evidence in favour of the Laporte-Inglis formula is obtained from the good agreement of the experimental values with those deduced from the formula using the appropriate value of the coupling parameter. L. A. W.

674. Raman Effect in Ammonia and Other Gases. C. M. Lewis and W. V. Houston. *Phys. Rev.* 44. *pp.* 903–910, *Dec.* 1, 1933.—The Raman rotation spectra of polyatomic molecules can be interpreted in terms of the polarisabilities of the molecule, without explicit knowledge of the electronic states. This point of view makes possible the calculation of the relative intensities of all rotation lines to be expected. The spectrum of gaseous ammonia shows the calculated intensity relations when a suitable shape is assumed for the molecule. The measurements are good enough to exclude the possibility of the case with three equal moments of inertia, and tend to support the flat pyramid inferred from infra-red data. The larger moment of inertia is $2\cdot79\times10^{-40}$ gm.cm^2. Methane shows no pure rotation band in spite of the presence of a vibration-rotation band. Ethane shows a rotation band which has not been resolved and an apparent vibration-rotation band which has not been interpreted. Ethylene gives a pure rotation band which indicates a moment of inertia of about 30.0×10^{-40}gm.cm^2., while acetylene shows a moment of inertia of $23\cdot52\times10^{-40}$ gm.cm^2. with alternating intensities as in hydrogen. AUTHORS.

675. Rotational Structure of the Raman Band (0000) → (020 ± 2) in Linear Symmetrical Molecules YX_2. J. R. Nielsen. *Phys. Rev.* 44. *pp.* 911–913, *Dec.* 1, 1933.—In connection with an attempt made by A. Langseth and the author [see Abstract 1068 (1933)] to interpret two faint lines in the Raman spectrum of carbon dioxide, the intensities have been calculated of the rotational lines associated with the transition (0000) → (020 ± 2) in linear symmetrical molecules *X–Y–X*. The results agree with the more general formulae recently obtained by Placzek and Teller by a formally different method. [See Abstract 3039 (1933).] AUTHOR.

676. Raman Effect in Solutions of Ammonium Nitrate in Nitric Acid. L. Médard and Thérèse Petitpas. *Comptes Rendus,* 197. *pp.* 1221–1222, *Nov.* 20, 1933.—The Raman spectrum of a solution in the proportions of 1 NH_4NO_3 to 2 HNO_3, and of binary mixtures of the two compounds in various proportions, are recorded. A band at 3200cm^{-1}. observed in solutions rich in NH_4NO_3 is attributed to vibrations of H-atoms, probably in the molecule $O_2N\text{–}O\text{–}H$. The binary mixtures show frequencies previously observed in nitric acid, and also those of the NO_3 ion. The effect of dilution with ammonium nitrate is similar to that of dilution with water [see Abstract 5343 (1933)]. C. B. A.

677. Raman Spectra of Substituted Unsaturated Cyclic Hydrocarbons. M. Godchot, E. Canals and Germaine Cauquil. *Comptes Rendus,* 197. *pp.* 1407–1409, *Dec.* 4, 1933.—The Raman spectra of a number of methyl and ethyl substitution products of pentene, hexene and heptene are observed and the frequencies given in tabular form. Comparison with the authors' previously published data for the corresponding unsubstituted hydrocarbons [see Abstract 2447 (1933)] reveals characteristic differences due to substitution. L. A. W.

678. Raman Spectra of Anhydrite and Anglesite. H. Nisi. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 463–469, *Dec.,* 1933. *In English.*—The Raman effect in anhydrite and anglesite was investigated. In anhydrite, the modified line due to the principal inactive vibration of the SO_4-group is single and its wave-number shift is larger than the corresponding one in gypsum by about ten units. Other modified lines split up into two or three components respectively, according as they are due to the two-fold or three-fold vibration; thus the SO_4-group seems to be somewhat distorted from a regular tetrahedron. However, this seems not to agree with the results obtained by X-ray analysis. The intensities of some lines are affected by the direction of observation. In anglesite, there appear three modified lines excited by a mercury line, and the wave-number shifts for them are very large, as compared with the cases of other sulphates. With respect to the intensities of the modified lines some irregularity is observed, too. AUTHOR.

679. Spectrographs Made Astigmatic by the Employment of Inclined Lenses. A. Couder. *Comptes Rendus*, 197. *pp.* 1199–1201, *Nov.* 20, 1933.—A method is described for broadening spectra by introducing astigmatism into a spectrograph. The lenses are pivoted on trunnions and adjusted to the required angle. Inclination of the collimator lenses produces astigmatism independent of wave-length while that of the camera lenses gives astigmatism which can be arbitrarily chosen for any region. W. R. A.

680. Sodium Glow Lamp. F. H. Newman. *Phil. Mag.* 16. *pp.* 1109–1114, *Dec.*, 1933.—After briefly reviewing the experiments of Warburg and Burt the author describes his own method for introducing sodium into a neon or argon glow lamp by a process of electrolysis. The ordinary commercial beehive lamp was used, the supply being 210 volts a.c., the internal ballast resistance having been removed from the cap and replaced by an external one of 400 ohms the lamp current being 0·15 ampere, considerably higher than the normal rated value. The lower half of the lamp bulb was then immersed in a bath of pure molten sodium nitrate into which was introduced a copper wire electrode connected to the positive terminal of a 105 volt d.c. supply the negative terminal being connected to the lead-in wire of the glow lamp. A resistance of about 600 ohms was connected in series in this circuit to limit the current flow. Electrolysis took place, a yellow glow appeared in the lamp, bubbles of gas were given off from the molten nitrate and a deposit of sodium formed on the cool upper part of the bulb. If in an argon lamp a portion of the glow remote from the electrodes be used, then this lamp acts as an excellent source of sodium D-line radiation the intensity being sufficient for calibration or comparison purposes. F. S. B.

681. Influence of a Magnetic Field on a Glow Discharge. T. Takamine, T. Suga and A. Yanagihara. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 454. *pp.* 69–96, *Oct.*, 1933. *In English.*—It is found that over a certain range of pressure the luminosity of the glow discharge in neon and helium is increased under the influence of an external magnetic field. There appears to be a close resemblance between the effect of a magnetic field and the effect obtained on increasing the pressure. In both cases there is an increase in the luminosity and the kathode dark space diminishes. In the case of helium a bright pink ring appears round the kathode when the magnetic field is applied, and it is noted that the spectrum given by this ring is mainly due to He_2 whereas the anode spot emits the line spectrum. A. H.

682. Light Emission in a Gas Discharge. W. de Groot. *Physica*, 1. *pp.* 28–34, *Dec.*, 1933. *In German.*—It is shown that replacing the integral equation for the number of excited atoms in a discharge tube by a second order differential equation leads to somewhat erroneous results, a divergent integral being involved. The behaviour of the Na lines is discussed in the light of this theory. F. S.

683. Spectral Analysis of Industrial Materials. H. Moritz. *V.D.I.* 77. *pp.* 1321–1326, *Dec.* 16, 1933.—A survey is given of spectral analysis, including descriptions of suitable apparatus for the arc and condensed and h.f. spark methods of excitation. Applications to the study of protective films, diffusion and segregation in alloys, and in medical practice are discussed. H. F. G.

See also Abstracts 401, 410, 578, 580, 584, 599, 604, 725, 734, 802.

VISION.

684. Anomalies of Colour Vision. Polack. *Comptes Rendus,* 197. *pp.* 1253–1254, *Nov.* 20, 1933.—It has been shown [see Abstract 227 (1934)] that the trichromatic theory does not agree with the facts of colour vision. By this theory, Daltonism is found to cover the Rayleigh type, since tables which are only supposed to give differences in tones are also affected by the luminosity. When the place in the spectrum of maximum luminosity and the extent of unitonal regions are expressed, they give more definition and form a continuous series with normal vision and its anomalies. H. M. B.

685. Neutral Value Scales. Part II. Comparison of Results and Equations Describing Value Scales. I. H. Godlove. *J.O.S.A.* 23. *pp.* 419–425, *Dec.,* 1933.—The relation between the value of a surface and its reflectance are discussed and the experimental results of Cobb and of the Munsell Laboratory are analysed. An empirical equation which takes account of the reflection factor of the background is proposed to fit the experimental observations. Other empirical relations are also reviewed. [For Part I see Abstract 5348 (1933).] W. D. W.

686. Theory of Colour Coordination. M. Sargant-Florence. *Roy. Soc. Arts, J.* 82. *pp.* 126–142 ; *Disc.,* 142–148, *Dec.* 15, 1933.—The paper discusses the relation between the musical scale and the spectrum and extends the analogy developed in Newton's " Opticks." On the basis of a recent investigation the author attempts to demonstrate the reality of some correlation between the normal diatonic octave and the octave of radiation frequencies included in the visible spectrum. In the *Discussion,* **J. Littlejohns** criticised the use of the colour circle and considered that more extensive experiments were required on the relation between the psychological effect of colours and the known properties of physical colour mixture. **J. Guild** emphasised that there were no scientific theories relating physics and aesthetics and pointed out that until æsthetic relations were compared with precise modern information on colour mixtures, the time spent on the subject was almost entirely wasted. W. D. W.

X-RAYS.

687. Atom Form Factor for X-Rays as a Problem of Dispersion Theory. (K Shell.) H. Hönl. *Ann. d. Physik,* 18. 6. *pp.* 625–655, *Nov.,* 1933.—The author develops a mathematical theory of the atom form factor for scattering of X-rays and derives an expression for F which deviates from the value F_0 corresponding to the simple geometric theory (scattering by a Schrödinger " charge cloud "), by an amount $\triangle$ F which varies with the X-ray wave-length and with the scattering angle, and which represents the effect of " anomalous dispersion " associated with the individual electron shells. The variation of $\triangle$ F with wave-length is worked out for frequencies near the K absorption edge and a comparison made with experimental data for iron and copper. Agreement is satisfactory. Variation of $\triangle$ F with scattering angle lies within the experimental accuracy attainable. W. S. S.

688. Atomic Factor Determinations in the Region of Anomalous Dispersion. K. Schäfer. *Zeits. f. Physik,* 86. 11–12. *pp.* 738–759, *Dec.* 7, 1933.—On the basis of investigations upon iron powders of different grain sizes but with coherent lattice regions of approximately the same size, it is shown that in determinations of the atomic factor by the method of admixture of a lighter element [see Abstract 2016 (1932)] a necessary condition for the applicability of the usual method of correcting for absorption is that the grain size must be less than a certain maximum value (in the present case 10^{-5} cm). A detailed discussion is given of the effect of grain size on the results obtained. New values of the atomic factors for iron and chromium are determined, the effect of grain size being avoided. For a constant wave-length, the difference between the observed value for iron and the value calculated according to Thomas-Fermi is found to be independent of the angle. The values for iron and chromium, reduced to zero scattering angle, are plotted against wave-length in the region of anomalous dispersion (both sides of K absorption edge) and good agreement is found with the curve calculated according to a new wave-mechanical theory of Hönl (in the press). L. A. W.

689. Anomalous Dispersion and Absorption of X-Rays. E. J. Williams. *Roy. Soc., Proc.* 143. *pp.* 358–376, *Jan.* 1, 1934.—The anomalous dispersion of X-rays is calculated from the experimental data for photoelectric absorption. Iron and copper are considered somewhat in detail and the results are compared with experiment. In the second part of the paper the relation between the oscillator strength calculated from the experimental data for absorption and the quantum-mechanical oscillator-strength for hydrogen-like electrons is discussed, particular attention being paid to the K continuum of oscillators, the observed strength of which is about 1·3. AUTHOR.

690. Relative Intensities of Certain L-Series X-Ray Satellites in Kathode-Ray and in Fluorescence Excitation. F. R. Hirsh, Jr., and F. K. Richtmyer. *Phys. Rev.* 44. *pp.* 955–960, *Dec.* 15, 1933.—Using a specially designed X-ray tube, the authors have measured the relative intensity of satellites and their parent $L\alpha_1$ line, for both kathode-ray and fluorescence excitation for the elements Zr(40), Mo(42), Ru(44), Rh(45), Pd(46) and Ag(47). Kathode-ray excitation was by 20 kV electrons. Fluorescence excitation was caused by the radiation from a target of Ag(47) bombarded by 20 kV electrons. A photographic method is used; in which spectrograms, Moll microphotometric records and density plots are made, from which it is possible to obtain the relative intensity of the satellites and their parent $L\alpha_1$ line. The results for fluorescence excitation suggest that *LM* ionisation is the most probable origin of the $L\alpha$ satellites. On the other hand, the rapid variation in relative intensity of the satellites with atomic number for kathode-ray excitation, seems to indicate that the peripheral electron structure of the atom plays a fundamental rôle in the production of satellites. The magnitude of the integrated intensity of the group of satellites accompanying $L\alpha$ varies from 10 % to 70 % of the intensity of the parent line, depending on the element and the method of excitation. AUTHORS.

691. Chemical Constitution and K-Absorption Spectra. O. Stelling. *Zeits. f. phys. Chem.* 23. *Abt.B.* 5–6. *pp.* 338–346, *Dec.*, 1933.—Compounds of the type $(\mathrm{Me\ A_4\ YCl})\mathrm{X}$ have been investigated with respect to their chlorine-X-ray absorption spectra. When Y is Cl or Br, the spectra for the trans- and cis-compounds are different, whilst they are identical when Y is a group co-ordinated by nitrogen. The Cl-X-ray absorption bands of kationoid complex-bound chlorine are not influenced by the anions so long as these are not chlorine, in which case they are then displaced. The configurations of the assumed stereoisomeric forms of chromium and cobalt dichrochlorides have been studied. H. H. Ho.

692. K-Absorption Discontinuities of the Elements Zirconium to Iodine. P. A. Ross. *Phys. Rev.* 44. *pp.* 977–983, *Dec.* 15, 1933.—A study of the K-absorption limits in the elements Zr, Cb, Mo, Ru, Rh, Pd, Ag, Cd, Sn, Sb, Te, and I has been made with a double-crystal spectrometer. All of the elements studied except cadmium show faint fine structure on the high frequency side of the discontinuity, the structure appearing as narrow bands of slightly decreased absorption lying within a range of from 21 to 120 volts of the main discontinuity. The width of the main absorption step in volts has been measured and found to increase with atomic number. Defining the wave-length of the absorption discontinuity as that corresponding to the point of inflection of the main absorption curve values of the wave-length have been obtained to an estimated accuracy of ± 0·02 X.U. AUTHOR.

693. X-Ray Diffraction in Long Chain Liquids. B. E. Warren. *Phys. Rev.* 44. *pp.* 969–973, *Dec.* 15, 1933.—The diffraction of X-rays in long chain liquids is calculated by the method of Zernicke and Prins. In the liquid, the long cylindrical molecules are arranged quite at random in space and orientation, except in so far as the condition for relatively dense packing necessitates that about any one long molecule, the nearest neighbours be roughly parallel. The main peak is due to a concentration of scattering matter at a distance about 8 % larger than the lateral distance between chains. The inner peak, which is observed for the alcohols and the fatty acids, measures the distance from the heavy end group to the gap at the opposite end. For relatively long chains this distance becomes equal to the chain length. AUTHOR.

694. X-Ray Emission Wave-Lengths in the M-Series by Means of the Ruled Grating. E. G. Purdom and J. M. Cork. *Phys. Rev.* 44. *pp.* 974–976, *Dec.* 15, 1933.—Measurements have been made by use of a plane ruled grating, of emission wave-lengths in the *M*-series for a number of elements having atomic numbers greater than (71). By making use of multiple positive orders, the correct determination of wave-lengths is secured even though uncertainties might exist in the position of the direct and reflected beams, or in the angle of incidence. The wave-lengths are found to be consistently greater than corresponding results obtained by means of the crystal method. The Moseley diagram for the results obtained are smooth curves. AUTHOR.

See also Abstracts 460, 480, 707, 708, 709.

HEAT.

CALORIMETRY.

695. Specific Heat of Aqueous Solutions of Phosphoric Acid. M. M. Popoff, S. M. Skuratoff and N. N. Feodossjeff. *Zeits. f. phys. Chem.* 167. *Abt.A.* 1–2. *pp.* 42–48, *Dec.*, 1933.—Data are presented for the true and mean specific heats for various temperature ranges and concentrations. [For description of calorimeter see Abstract 721 (1934).] L. G. C.

696. Specific Heat of Metallic Rhenium. F. M. Jaeger and E. Rosenbohm. *K. Akad. Amsterdam, Proc.* 36. 8. *pp.* 786–788, 1933.—The specific heat of rhenium at constant pressure has been measured by the method of mixtures over the range 0° to 1200° C. The correction to obtain the specific heat at constant volume cannot be made owing to lack of knowledge of the compressibility. L. G. C.

697. Heat Capacities of KCl, KNO_3 and $NaNO_3$ at Low Temperatures. J. C. Southard and R. A. Nelson. *Am. Chem. Soc., J.* 55. *pp.* 4865–4869, *Dec.*, 1933.—The molal heat capacities of KCl, KNO_3 and $NaNO_3$ were determined in the range from 15° to 290° K. The molal entropies of these compounds at 298·16° K. are found to be $19\cdot75\pm0\cdot06$, $31\cdot77 \pm 0\cdot10$ and $27\cdot87 \pm 0\cdot08$ cal./mol./deg., respectively. The free energies of formation of these salts from the elements are calculated. [See Abstract 243 (1934).] AUTHORS.

698. Calorimeter for the Combustion of Chlorine and Bromine Derivatives. M. M. Popoff and P. K. Schirokich. *Zeits. f. phys. Chem.* 167. *Abt.A.* 3. *pp.* 183–187, *Dec.*, 1933.—The free Cl_2 or Br_2 formed during the combustion of these compounds may be reduced to HCl by means of aqueous arsenious acid solution. This reaction is, however, slow and the calorimeter now described is consequently made rotatable in order to accelerate it. Measurements made with a number of aliphatic and aromatic halogen derivatives gave results accurate to within 0·1 %, except with ethylene bromide (0·5 %). T. H. P.

See also Abstracts 721, 732, 734.

CONDUCTION.

699. Influence of Magnetic Fields on Heat Conduction in Paramagnetic Gases. H. Senftleben and J. Pietzner. *Phys. Zeits.* 34. *pp.* 834–835, *Nov.* 15, 1933.—The authors showed in an earlier paper [see Abstract 3670 (1933)] that the heat conduction in paramagnetic gases is reduced by the action of a magnetic field. New measurements are given here which are to be used as a basis of a theory to explain the effect; in particular, it is shown that the occurrence of the effect is not necessarily bound up with the collision of oxygen molecules with each other but that the magnetic field also acts on the transference of energy between molecules of oxygen and other molecules. H. L. B.

700. Absolute Measurement of Thermal Conductivity of Gases. P. Vernotte. *Comptes Rendus,* 197. *pp.* 1395–1397, *Dec.* 4, 1933.—The apparatus consists of a cylinder, *A*, of duralumin of heat capacity *C*, raised to temperature $V°$; this is enclosed in a second cylinder, B, 15 mm. thick, and maintained at $W°$ (approximately $= V-15$), which is separated from A by a layer of gas ϵ (approximately 0·5) mm. across. The coefficient of conductivity, k, of the intervening gas is then given by the equation $C\Delta V = kS\ (V-W)\Delta t/\epsilon$, where S is the area of thermal exchange and Δt the number of seconds in which A cools by $\Delta V°$. C. A. S.

701. Friction, Heat Conduction and Diffusion in Mixtures of Gases. Part XXIV. M. Trautz. *Ann. d. Physik*, 18. 7. *pp*. 816–832, *Dec.*, 1933.—A continuation of the account of work on the measurement of friction in gaseous mixtures. A comparison is given of the author's equations and constants with those of Maxwell, Enskog and Chapman. [For Part XXIII see Abstract 3080 (1933).] J. J. S.

CONVECTION.

702. Convection and Heat Transfer. Part I. M. Jakob. *Die Physik*, 1. 4. *pp*. 153–162, 1933.—The author summarises the contributions which have been made within the last four years to the subject of heat transfer by free and forced convection, evaporation and condensation. R. W. P.

703. Theoretical Basis for the Behaviour of Controlled Time-Temperature Curves. E. L. Skau and W. H. Langdon. *Nat. Acad. Sci., Proc.* 19. *pp*. 943–947, *Nov.*, 1933.—In order to make a study of the agreement attainable between the theoretical time-temperature curve and the experimental data as determined by an apparatus already described [see Abstract 1940 (1933)] the following propositions have been established: (1) If C_p is constant with respect to the temperature, $\theta_s - \theta$ rapidly approaches the constant value $\frac{C_p}{K}\frac{d\theta_s}{dt}$, where C_p is the specific heat at constant pressure, t is the time, θ_s and θ are the temperatures of the shield and of the sample, respectively, and K is a constant of the apparatus. (2) For the case where $\frac{d\theta_s}{dt}$ is a positive constant (a heating curve) of C_p is constant for a sufficiently long period to attain the steady state of (1), and if at some later time, t_1, C_p starts to increase with the temperature, the curve becoming concave upward at θ_1 (corresponding to t_1), it follows that the temperature curve for the sample is concave downward for all values of t greater than t_1. H. H. Ho.

DILATATION.

704. Expansion Coefficients and Compressibilities of Gases. J. B. M. Coppock. *J. Phys. Chem.* 37. *pp*. 995–999, *Nov.*, 1933.—The coefficient of expansion at constant pressure, and the pressure coefficients at constant volume are calculated for 13 gases from the equation of state due to Beattie and Bridgeman [see Abstract 2953 (1927)]. In nearly all cases the calculated values agree very well with the experimental results. A formula for the compressibility of a gas over a wide range of temperature is derived and used to calculate the compressibility of nitrogen from − 100° to 100° C. J. P. A.

705. Effect of Heat Treatment on the Expansivity of a Pyrex Glass. J. B. Saunders and A. Q. Tool. *Bureau of Standards, J. of Research*, 11. *pp*. 799–810, *Dec.*, 1933.—Heating a pyrex glass at different

temperatures between 450° and 750° C. caused its mean linear expansivity between 20° and 200° C. to change more than 10 %. This expansivity in the case of the original untreated specimen was approximately $0{\cdot}0341 \times 10^{-4}$ and after treatment at temperatures near 750° C. it increased to $0{\cdot}0345 \times 10^{-4}$, while treatments at 450° C. reduced it to $0{\cdot}0307 \times 10^{-4}$. After any such changes the original expansivity could be restored by a heat treatment near 650° C. Treatments between 650° and 450° C. appeared to reduce the expansivity rather steadily as the treating temperature was lowered. These results indicate that there is some advantage in annealing this glass at the lowest practical annealing temperature since any reduction in the expansivity should increase the resistance of the glass to heat shock.
AUTHORS.

706. Linear Expansion and α–γ Transformation Temperature of Pure Iron. J. B. Austin and R. H. H. Pierce, Jr. *Physics*, 4. *pp.* 409–410, *Dec.*, 1933.—Results of the measurements of the linear thermal expansion of specially purified iron between room-temperature and 950° C are quoted. The following table summarises the values of the coefficient at different temperatures :—

Sample.	100	200	300	400	500	600	700	800
(*a*) Powdered carbonyl iron sintered in hydrogen for 18 hrs. at 1500° C ...	12·7	13·6	14·6	16·7	16·8	16·3	16·1	16·5
(*b*) Powdered carbonyl iron melted in hydrogen ...	12·7	13·8	14·6	16·6	16·8	15·8	15·2	14·9

With rising temperature the temperature-coefficient of the true expansion increases, passes through a maximum between 400 and 500° C. and falls to a minimum at or very near, the Curie point. It then increases again to the point of change from the α to γ transformation, *i.e.*, from a body-centred to face-centred lattice. A point of inflection occurs at the Curie point on the length-temperature curve, but no abrupt discontinuity. From Ebert's rendering of Grüneisen's equation for the calculation of the thermal expansion of iron from heat capacity data, it is predicted that the ratio of the expansion coefficient to C_p should be constant with temperature. From the present experimental results it is evident that proportionality continues with reasonable accuracy until the effects of magnetic inversion appear. Grüneisen's equation appears to be invalid at the Curie point as far as macroscopic expansion is concerned. S. G. B.

707. Coefficient of Expansion of Silver by X-Ray Method. H. Saini. *Helv. Phys. Acta*, 6. 8. *pp.* 597–607, 1933. *In French.*—The coefficient of expansion of silver between 20° C. and 300° C. is measured, a modified form of a Seeman-Böhlin camera being used. The camera is in two portions, one carrying the specimen and the other, which is water-cooled, carrying the film. The temperature is measured by a copper-constantan thermocouple. Methods for eliminating various errors are given. The lattice constant at 18° C. is found to be $4{\cdot}0774_0$ Å. The coefficient of expansion is $(19{\cdot}1 \pm 0{\cdot}2) \times 10^{-6}$ per degree. J. T.

708. Thermal Expansion of the Crystal Lattices of Silver, Platinum and Zinc. E. A. Owen and E. L. Yates. *Phil. Mag.* 17. *pp.* 113–131, *Jan.*, 1934.—A high temperature precision X-ray camera has been employed to study the expansion of Ag, Pt and Zn. The specimens were heated *in vacuo* when exposed to the X-rays. Values of the coefficients

of thermal expansion of Ag and Pt were obtained which agreed closely with previously determined values for these elements. The range of temperature for Ag was extended from 300° C. to 600° C. The thermal expansion of Zn was measured along and perpendicular to the hexagonal axis for temperatures ranging from 20° C. to 415° C. The Zn lattice was found to continue to expand up to within about 4° C. of the melting-point. Expansion occurred both along and perpendicular to the hexagonal axis up to this temperature, but whereas the rate of change of base side increased, that of the height decreased as the melting-point was approached. From the results approached with zinc, it is concluded that the thermal expansion of the crystal lattice is the same as that of the material taken as a whole.
AUTHORS.

709. Thermal Expansion of Bismuth by X-Ray Measurements. A. H. Jay. *Roy. Soc., Proc.* 143. *pp.* 465–472, *Jan.* 1, 1934.—X-ray powder photographs of bismuth have been taken at temperatures ranging from 18·5° C. to 268° C. (melting point of bismuth 271° C.), and the lattice dimensions calculated for each temperature observation. The lattice expansions are compared with those found by the use of optical methods. Roberts from optical measurements found an almost linear expansion up to 240° C., followed by a decrease in the coefficient of expansion near the melting point. These characteristics were later confirmed by Ho, who in addition found evidence of a discontinuity in the coefficient of expansion at 75° C. which he associated with an allotropic change. Goetz and Hergenrother, from X-ray measurements with single crystals, found no evidence either of a lattice discontinuity at 75° C., or of a decrease in the coefficient of expansion near the melting point. Their results showed a progressive increase in the coefficient of expansion of the lattice from room-temperature right up to the melting point. The results of the present X-ray measurements made with bismuth powder disagree with the findings of Goetz and Hergenrother and show that the lattice expansion agrees with the expansion of the specimen as a whole. Briefly the characteristics of the expansion curve are a steady expansion from 20° C. to 70° C., a sudden rise between 70° C. and 80° C., a linear expansion up to 240° C., and above 250° C. a decrease in the coefficient of expansion. The nature of the changes in the lattice dimensions just below the melting point are discussed.
AUTHOR.

MELTING AND BOILING POINTS.

710. Simple Apparatus for Determination of Melting and Boiling Points, etc. of Small Quantities of Material. S. Watanabe. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 466. *pp.* 264–268, *Nov.*, 1933. *In English.*—The material under test is suspended in an enclosure which can be gradually heated or cooled. The absorption or evolution of heat by specimens weighing only about 0·01 gm. is recorded by means of a pair of thermojunctions differentially connected together, one junction being immersed in the specimen and the other just outside it. The temperature of the enclosure is recorded by a third thermojunction. Examples given include the determination of the ignition temperature of S and a record of the explosion of gunpowder.
R. W. P.

711. Dependence of the Volume and Solidifying Point of Carbon Tetrachloride on the Thermal Pre-Treatment. W. Brüll. *Zeits. f. Elektrochem.* 40. *pp.* 8–10, *Jan.*, 1934.—Repetition of previous experiments has revealed sources of error: marked retention of air by solid CCl_4 and appreciable hysteresis of the Beckmann thermometer. The volume effects noted are hence erroneous and the deviations of the solidifying point are smaller than those given, even if they exist at all. [See also Abstract 4973 (1933).] T. H. P.

712. Supposed Allotropy of Nitrobenzene. E. Cohen and L. C. J. te Boekhorst. *Zeits. f. phys. Chem.* 24. *Abt.B.* 2–3. *pp.* 241–258, *Jan.*, 1934.—Nitrobenzene was prepared in two entirely different ways. The freezing point of both samples in an atmosphere of dry hydrogen was $5\cdot76\pm0\cdot01°$ C. The specific volume was determined by a dilatometer method between $1\cdot4°$ C. and 20° C. and was found to agree with that given by the expression $0\cdot81759+0\cdot0_{3}6634\,t+0\cdot0_{6}48\,t^{2}$ within $0\cdot00002$ cm^{3}/gm. In an atmosphere of moist air the nitrobenzene with $0\cdot05$ % of water had a melting point $5\cdot5_{4}°$ C., which agrees with the results of Wolfke and Mazur. The specific volume determined between 4° C. and 17° C. was given by $0\cdot81778+0\cdot0_{3}6634\,t+0\cdot0_{6}48\,t^{2}$ cm^{3}/gm. Exposure to light for two months very slightly increased the density. The viscosity was determined between 3° C. and 20° C. with a viscometer described by Cohen and Bruins. The observed results agreed within $\pm0\cdot03$ with $31\cdot98_{9}+0\cdot80348\,t+0\cdot002742\,t^{2}$. Exposure to light produced no measurable change. The viscosity in damp air was given by $31\cdot92_{9}+0\cdot80348\,t+0\cdot002742\,t^{2}$. The discontinuity at about 10° C. found in the specific volume and the viscosity by Wolfke and Mazur [see Abstract 2483 (1932)] was not confirmed in nitrobenzene either pure or damp. P. H. B.

713. Apparatus for Rectifying Small Quantities of Liquefied Gas, and Purification of Krypton. H. van Dijk, J. Mazur and W. H. Keesom. *K. Onnes Lab., Leiden, Comm. No.* 228. *K. Akad. Amsterdam, Proc.* 36. 9. *pp.* 820–825, 1933.—An apparatus is decribed with which it is possible to purify a relatively small quantity of gas by rectification according to Claude's principle of *retour en arrière*. This method has been tested for the purification of krypton and satisfactory results have been obtained. AUTHORS.

See also Abstracts 604, 702, 773.

TEMPERATURE, MEASUREMENT OF.

714. Adiabatic Cooling of Paramagnetic Salts in Magnetic Fields. W. J. de Haas, E. C. Wiersma and H. A. Kramers. *Physica,* 1. *pp.* 1–13, *Dec.*, 1933.—A description of the apparatus used for obtaining very low temperatures by the method of adiabatic demagnetisation is given. The method is discussed. Measurements have been carried out on cerous fluoride, dysprosium ethylsulphate and cerium-ethylsulphate. The latter salt gave the lowest temperature of $0\cdot08^{5}$ °*K*. Difficulties in fixing the temperature scale are discussed. [See Abstracts 4975 and 5070 (1933).] AUTHORS.

715. Sources of Error in Liquid Thermometers. W. Grundmann. *Zeits. f. Physik,* 86. 7–8. *pp.* 550–554, *Nov.* 15, 1933.—The accuracy of temperature measurement possible with liquid thermometers is appreciably affected by the behaviour of the indicating liquid as regards compressibility, gas absorption, distillation and contraction. The additive effects of these factors give possible errors of temperature measurement with liquid thermometers which considerably exceed the usually accepted tolerances. Experiments in confirmation of the theoretical conclusions are described. A. W.

716. Temperature Control. W. E. Hoare. *Electrician,* 111. *pp.* 715–717, *Dec.* 8, 1933.—The importance of temperature control in modern industrial processes is outlined and the general principles underlying the construction of suitable apparatus for this purpose are given. The design of a constant temperature room is described with particular reference to the choice of material for the walls and of its disposition. Various types of temperature regulator for constant temperature rooms are described and the most suitable method of using them is discussed. Mercury-in-glass, air and water thermostats for low temperature control are described. An accurate form of mercury-in-glass thermostat operating to within 0·005° C. under favourable conditions is described. The most suitable form of heater unit for thermostats of this type is probably the radiator lamp (250 W). Furnace thermostats are usually of the thermoelectric or electrical resistance type, although air thermometers have recently been applied with success. The arrangement of the electrical components of an accurate form of furnace thermostat is outlined. Improvement in uniformity of temperature in large furnaces may be secured by the use of fans, constructed of heat resisting alloys and run at the furnace temperature; in addition, faster heating rates can be employed without damage to the furnace wall. H. J. H. S.

717. Sensitive Thermostat Regulator. C. E. Woodworth. *Science,* 78. *pp.* 535–536, *Dec.* 8, 1933.—A simple and inexpensive thermostat is described for use over the range 0 to 35° C., which is capable of maintaining a bath constant to within 0·001° C. for relatively long periods. R. W. P.

718. Eddy Current Cryostats. E. Justi. *Phys. Zeits.* 35. *pp.* 3–6, *Jan.* 1, 1934.—A discussion of the nature and magnitude of the temperature gradients in a metal block thermostat for use over the range 1 to 120° Abs. shows that it is possible to construct one which has no conductors (thus diminishing thermal loss) and in which the radial and vertical temperature gradients are practically overcome (instead of being compensated). The thermostat is made of glass and eddy currents are used to generate heat in a mass of mercury at such a rate that the temperature is kept constant. H. J. H. S.

719. Production of Very High Pressures and Temperatures. C. Ramsauer. *Phys. Zeits.* 34. *pp.* 890–894, *Dec.* 15, 1933.—An apparatus is described for obtaining very high pressures by arranging two coaxial tubes so that a projectile fired from one enters the other and compresses the gas in it. The density, pressure and temperature of the gas are calculated (for A, N_2 and CO_2) on the assumption that the gas is perfect and that adiabatic conditions obtain. The velocity of the projectile is measured by a photographic method and corrections are applied for frictional losses and departure from the ideal gas laws. The application of the method as a means of extending knowledge of some physical properties at high pressures is discussed. H. J. H. S.

See also Abstracts 452, 617, 710.

THERMOCHEMISTRY.

720. Heats of Dilution of Aqueous Solutions of Zinc, Cadmium and Copper Sulphates and Sulphuric Acid at 25°. E. Lange, J. Monheim and A. L. Robinson. *Am. Chem. Soc., J.* 55. *pp.* 4733–4744, *Dec.*, 1933.—The heats of dilution of aqueous solutions of cadmium, copper and zinc sulphates (from 1 M to 0·00005 M) and sulphuric acid (from 0·05 M to 0·00005 M) were measured calorimetrically at 25° and extrapolated to infinite dilution to obtain integral heats of dilution. Additional heat effects accompanying the dilution of very dilute electrolyte solutions due to the displacement of the equilibrium $H_2O \rightleftharpoons H^+ + OH^-$ are discussed. Relative partial molal heat contents and, for zinc sulphate, other related partial molal quantities (real and ideal) are calculated for the concentration range of the measurements. AUTHORS.

721. Determination of Heat of Solution. M. M. Popoff, K. G. Chomjakoff, N. N. Feodossjeff and P. K. Schirokich. *Zeits. f. phys. Chem.* 167. *Abt.A.* 1–2. *pp.* 29–34, *Dec.*, 1933.—The determination of the heat of solution of KCl has been carried out by two methods, *viz.*, by the method in which correction is made for heat exchange and by the adiabatic method. The results so obtained agree, the heat of solution of KCl in 200 moles of water being found to be − 4·376 ± 0·1 % k.cal. at 15° C. L. G. C.

722. Heats of Formation of Mixed Crystals from KCl and KBr. M. M. Popoff and S. F. Jaworowskaja. *Zeits. f. phys. Chem.* 167. *Abt.A.* 3. *pp.* 180–182, *Dec.*, 1933.—In the crystallisation of 20 gm. of the mixed salts, homogeneous mixed crystals are formed only after about 90 min. The mode of cooling has no influence on the heats of formation of equally-tempered mixed cystals, but the duration of tempering does affect the heat of formation. It was not found possible by grinding methods to obtain mixed crystals with the same heat of formation as those crystallised from the liquid phase. [See Abstract 3264 (1930).] T. H. P.

723. Thermochemical Measurements on Oxides of Copper, Rhodium, Palladium and Iridium. L. Wöhler and N. Jochum. *Zeits. f. phys. Chem.* 167. *Abt.A.* 3. *pp.* 169–179, *Dec.*, 1933.—Calculation of the heat of dissociation of CuO from the experimental oxygen-pressures of the oxide gives results disagreeing with the values previously determined. Measurements have hence been made of the heats of formation of the two oxides of copper directly by reduction with hydrogen, and of their specific heats, in order to calculate the corresponding pressures. Similar measurements have been made with the oxides of rhodium, palladium, and iridium. In all cases, agreement is found between the calculated and experimental pressures. Support is thus furnished for the accuracy of the new values obtained for the heats of formation. The molecular heats of formation (k.-cal.) are given as: IrO_2, 40·14; CuO, 33·02; Cu_2O, 43·00; PdO, 20·40; Rh_2O_3, 68·30; RhO, 21·72; Rh_2O, 22·70. Certain of these values differ appreciably from those found in the literature. T. H. P.

724. Heats of Formation of Cadmium Oxide, Cadmium Hydroxide and Zinc Oxide. G. Becker and W. A. Roth. *Zeits. f. phys. Chem.* 167. *Abt.A.* 1–2. *pp.* 1–18, *Dec.*, 1933.—The heats of formation of cadmium oxide, cadmium hydroxide and zinc oxide were determined by a new method, which ensured the complete combustion in a bomb calorimeter. The oxides obtained were utilised to check the value obtained, by the indirect determination of the heats of formation from the heats of solution. The method was applied to the determination of the heats of formation of niobium and tantalum pentoxides. F. J. B.

725. Energy of Dissociation of Water by Symmetrical Vibrations and the Products of the Dissociation. M. Magat. *Comptes Rendus,* 197. *pp.* 1216–1218, *Nov.* 20, 1933.—The constants in Born and Brody's equation for coupled nonharmonic oscillations have been determined, and the calculated vibration frequencies of water compared with the observed values; the difference is rarely greater than 7 cm.^{-1}. The calculated energy of dissociation by symmetrical vibration is 269 ± 3 k.cal., as compared with 212 ± 1 k.cal. calculated from thermal and spectroscopic data; the difference of 51 k.cal. is the energy of activation of oxygen ($^3P \rightarrow {}^1D$), from which it appears that the primary products of the thermal dissociation of water are normal hydrogen and activated oxygen.
H. F. G.

726. Combustion of Hydrocarbons. W. A. Bone. *Chem. Soc., J. pp.* 1599–1617, *Dec.,* 1933.—Experimental work is reviewed relating to the slow combustion, flame combustion and explosion of hydrocarbons, carried out principally in the author's laboratory. Results obtained in slow combustion experiments support the author's hydroxylation theory of combustion, which is extended to include the results of explosive combustion. The results do not support the peroxidation theory.
J. S. G. T.

727. Flame Temperatures in Carbon Monoxide and Air Mixtures. W. T. David and J. Jordan. *Phil. Mag.* 17. *pp.* 172–181, *Jan.,* 1934.—In continuation of previous work [see Abstract 1669 (1932)] two series of measurements have been made of the temperatures recorded during the pre-pressure period in explosions of CO and air at pressures of 1 and 5 atmospheres, respectively, the temperatures being measured by platinum-rhodium wires 0·0005 in. dia. and 2 in. long. The difference between the ideal temperature, *i.e.*, the temperature which the products should attain when burned completely at constant pressure, and the measured temperature is found to be very much greater for strong mixtures than for weak and very over-rich mixtures. This result is not attributable to radiation loss either from the wire or from the products of combustion. J. S. G. T.

See also Abstracts 412, 425, 671, 697, 698, 710.

THERMODYNAMICS.

728. Density of Propylene in the Liquid and Vapour Phases Near the Critical Temperature. C. A. Winkler and O. Maass. *Canad. J. of Research,* 9. *pp.* 610–612, *Dec.,* 1933.—The density of propylene in the liquid and vapour phases was measured over the range 66° to 92° C. by a refined dilatometer method and at the higher temperatures at the same time by a float method. Good agreement was found between the two methods, the latter being preferable in the neighbourhood of the critical temperature. It was found that at temperatures below the critical no variation in vapour density accompanied a change in the relative volume of the liquid. The data were obtained principally for an investigation to be published simultaneously on discontinuities above the critical temperature. [See following Abstract.] Authors.

729. Density Discontinuities at the Critical Temperature. C. A. Winkler and O. Maass. *Canad. J. of Research,* 9. *pp.* 613–629, *Dec.,* 1933.—A technique for measuring densities in various parts of a one- or two-component system, raised above its critical temperature, is described. Considerable improvements over a method for this purpose recently described by one of the writers consist in greater flexibility of manipulation and in making possible a variation in the volume of space confining the medium during the experiment. Propylene and methyl ether were the two media examined. From the results generalisations regarding aberrations from the continuity of state were found to hold for both. Their theoretical significance is discussed to the extent warranted by the present stage of the experimental investigations, and tentative conclusions are drawn. [See preceding Abstract.] Authors.

730. Barometric Formula for Real Gases and Its Application Near the Critical Point. R. Ruedy. *Canad. J. of Research,* 9. *pp.* 637–640, *Dec.,* 1933.—According to the theory of the continuity of liquid and gaseous states, as expressed for instance in van der Waals' equation, pronounced density differences may exist in a short column of fluid maintained, throughout its length, at the critical temperature. The point in the tube at which the density of the contents has decreased a given percentage from the critical value is the higher the larger the ration of the critical temperature to molecular weight. For substances like neon the variations are so large that a measurable separation of isotopes may be expected at or near the critical point; for other substances the computed results are at least of the magnitude found by experiment. Also, according to the theory, in order to obtain, at or near the critical point, a column of gas of uniform density a temperature gradient must be allowed to exist along the column. Author.

731. Thermodynamic Diagrams of Liquid Helium. W. H. and (Miss) A. P. Keesom. *K. Onnes Lab. Leiden, Suppt. No.* 76*b. Physica,* 1. 2. *pp.* 128–133, *Dec.,* 1933.—The thermal properties of liquid helium are described by means of two diagrams which represent p (pressure) or ρ (density) as functions of T (temperature). A table is also given for ρ as a function of T and p. Diagrams have been derived for the first differential coefficients: $(\delta\rho/\delta p)_T$, $(\delta p/\delta T)_\rho$ and $(\delta\rho/\delta T)_p$. These diagrams clearly show the discontinuities which occur in the differential coefficients when passing the λ-curve. [See Abstract 4754 (1933).] Authors.

732. Thermodynamic Properties of Trifluorotrichloroethane and Difluorotetrachloroethane. F. Hovorka and F. E. Geiger. *Am. Chem. Soc., J.* 55. *pp.* 4759–4761, *Dec.,* 1933.—The following physical properties for $C_2F_2Cl_4$ and $C_2F_3Cl_3$ have been determined over a wide temperature range: density, index of refraction, surface tension, vapour pressure and viscosity. Critical temperatures, molal heat of vaporisation, parachor and vapour pressure-temperature equation have been calculated for each liquid. AUTHORS.

733. States of Aggregation. K. F. Herzfeld and Maria Goeppert-Mayer. *J. Chem. Phys.* 2. *pp.* 38–45, *Jan.*, 1934.—The problem of investigating systematically the possible states of aggregation has not yet been attacked. It has been approached here in the hope of getting a deeper insight into the nature of the liquid state. After a discussion of the general methods, a simplified one-dimensional model is introduced. It was possible to find the exact equation of state. However, it turned out that in this case a single (gaseous) state exists. This is due to the presence of aggregates of all sizes. It is found that the existence of at least one condensed state is possible only if the change in free energy that occurs when an atom is added to a large aggregate is higher than the change that occurs in the addition of this atom to a small molecule. No progress could be made in the understanding of the liquid state. AUTHORS.

734. Heat Capacity, Heat of Vaporisation and Entropy of Nitrogen, and Kinetics of Reaction $\frac{1}{2}N_2 + \frac{1}{2}O_2 = NO$ from Spectroscopic Data. W. F. Giauque and J. O. Clayton. *Am. Chem. Soc., J.* 55. *pp.* 4875–4889, *Dec.*, 1933.—The heat capacity of the two crystalline forms and of liquid nitrogen has been measured from 15° K to the boiling point. The transition, melting and boiling points are 35·61, 63·14, and 77·32° K, respectively. The calorimetric heats of transition, fusion and vaporisation (at 760 mm.) are 54·71, 172·3, and 1332·9 per mole, respectively, from the calorimetric measurements and the third law of thermodynamics the entropy of nitrogen at its boiling point was found to be 36·3 ± 0·1 E.U. A 0·2 E.U. correction for gas imperfection, using Berthelot's equation, gives 36·5 E.U. as the entropy of the ideal gas at 77·32° K. The entropy was also calculated from band spectra data; at 77·32° K it is 36·416 E.U. At 298·1° K, S = 45·788 calories per degree per mole. None of the above entropy values contain the amount of entropy due to nuclear spin. The absolute entropy at 298·1° K is $45{\cdot}788 + R \log 9 = 50{\cdot}154$ E.U. It is concluded that, although lack of equilibrium between the two series of " non-combining " states of nitrogen persists into the solid state at 13° K, no molecular rotation remains in the solid at this temperature, as is the case in hydrogen. The vapour pressure of solid nitrogen at 54·78 to 63·14° K is given by $\log_{10}P \text{ (cm)} = -(381{\cdot}6/T) + 7{\cdot}41105 - 0{\cdot}0062372T$, and of liquid nitrogen at 63·14 to 78·01° K by $\log_{10} P\text{(cm.)} = -(339{\cdot}8/T) + 6{\cdot}71057 - 0{\cdot}0056286T$. The free energies and equilibrium constants for the reactions $\frac{1}{2}N_2 + \frac{1}{2}O_2 = NO$ and $N_2 = 2N$ have been calculated to 5000° K. The free energy of formation of NO is $\triangle F^{\circ}_{298{\cdot}1} = 20650$ calories per mole.

H. H. Ho.

735. Thermodynamics of Aqueous Solutions of Sodium Hydroxide from E.M.F. Measurements. H. S. Harned and J. C. Hecker. *Am. Chem. Soc., J.* 55. *pp.* 4838–4849, *Dec.*, 1933.—The e.m.f. of the cells $H_2/NaOH(m)/Na_xHg/NaOH(0{\cdot}05)/H_2$ were made at 5° intervals from 0° 35° C. From the results of the measurements the activity coefficients, relative partial molal heat contents and heat capacities of sodium hydroxide from 0° to 35° C were calculated. The data so obtained were in good agreement with calorimetric data. An extrapolation formula for the calculation of the partial molal heat content is developed. F. J. B.

See also Abstracts **425, 492, 502, 604, 697, 704.**

VAPOUR PRESSURE.

736. Vapour Pressure of Vinyl Acetate. J. Marsden and A. C. Cuthbertson. *Canad. J. of Research,* 9. *pp.* 419–423, *Nov.,* 1933.—This paper presents the results of the measurement of the vapour pressure of vinyl acetate, over the temperature range from 0° C. to the normal boiling point. The determinations were carried out on vacuum distilled samples with an isoteniscope. The normal boiling point is 72·5° C. The molecular heat of evaporation has been found to be 8211 cal. The equation which represents the results is $\log_{10}P_{\text{mm.}} = \frac{-0\cdot 05223 \times 34433}{T} + 8\cdot 091$. Trouton's constant and the critical temperature have been found to be 23·8 and 228·3° C. AUTHORS.

737. Partial Pressures of Water in Equilibrium with Aqueous Solutions of Sulphuric Acid. E. M. Collins. *J. Phys. Chem.* 37. *pp.* 1191–1202, *Dec.,* 1933.—A redetermination of the aqueous partial pressures over aqueous sulphuric acid solutions has been made for concentrations up to 70 % H_2SO_4 from 20° C. to 140° C. For this purpose an isoteniscope was devised which could measure vapour pressures of solutions with no accompanying change in the concentration of the solution. From the observed data a table of relative vapour pressures has been compiled, from which table it is possible to ascertain the aqueous partial pressure for aqueous solutions of H_2SO_4 between 0 and 70 % H_2SO_4 for any temperature from 20° C. to 140° C. inclusive. The heats of vaporisation of water from solutions of the above range of concentration and temperature have been calculated and tabulated. AUTHOR.

See also Abstracts **505, 732, 734.**

ACOUSTICS.

738. Semi-Stationary Waves. E. J. Irons. *Rev. d'Acoustique,* 2. *pp.* 211–213, *May,* 1933.—The conventional representation of a semi-stationary wave is misleading chiefly in that it appears to indicate that particles in the path of such a wave simultaneously occupy their positions of equilibrium twice during each cycle. The true character of the waves is illustrated by two diagrams, one shewing the displacements of particles at intervals of one eighth of a cycle, and the other shewing a series of displacement-time curves for particles lying between a partial-node and an antinode. An apparatus by which the properties of these waves may be demonstrated is described. E. J. I.

739. Related Nodal Lines on Square Membranes. Part I. R. C. Colwell and J. K. Stewart. Part II. R. C. Colwell, L. R. Polan and E. W. Noland. *Frank. Inst., J.* 216. *pp.* 763–773, *Dec.,* 1933.—Continuing previous investigations [see Abstract 1974 (1933)], the parameters which occur in the equation for the nodal lines on a square membrane are varied systematically, and the corresponding figures drawn. In Part II some photographs of sand figures are given in illustration.

J. P. A.

740. Liquid Films in a Vibrating Air Column. N. W. Robinson and R. W. B. Stephens. *Phil. Mag.* 17. *pp.* 27–33, *Jan.,* 1934.—It was attempted to denote the positions of nodes and antinodes in a Kundt's tube by the use of a series of plane parallel soap films about 1 cm. apart and perpendicular to the axis of the tube. The films were produced as described previously [see Abstract 1362 (1933)]. A loud speaker sounding at one end of the tube caused the films to vibrate. The film system responded most to the frequencies 740, 840, 930, 1010, 1060, 1240 and the distance between consecutive antinodes was the same for all these frequencies. Hence the membranes do not act as true acoustic indicators but affect the mode of vibration of the system. Widely separated films were passed slowly along the tube and the antinodes were located by their violent disturbance or bursting. By this means, using a frequency 957, the velocity of sound in the tube was found to be $3 \cdot 26 \times 10^4$ cm./sec. The nature of the vibrations of single liquid films was investigated. A film 2·5 cm. diameter was formed across an orifice in a resonator rigidly attached to a loud speaker. At certain frequencies standing wave patterns showed radial and circular nodal lines. The resonance persisted independently of the natural resonance of the air column. Work is in progress. Photographs are appended. P. H. B.

741. Ultrasonic Waves. Part III. P. Biquard. *Rev. d'Acoustique,* 2. *pp.* 288–299, *July,* 1933.—The author discusses problems in ultrasonics by the aid of useful relations derived from first principles. He is here concerned with problems on waves incident from a liquid to (*a*) an infinite solid, and (*b*) a solid of finite thickness; and on the emission of waves by a pulsating slab. [For Part II see Abstract 3713 (1933).]

E. J. I.

742. Acoustics of Spaces with Wooden-Covered Surroundings. E. Meyer and L. Cremer. *Zeits. f. techn. Physik,* 14. 11. *pp.* 500–507, 1933.—Wooden-lined buildings have the two following effects on the acoustics of halls: (1) since sound travels faster in wood than in air, the sound waves may be distributed more quickly through the hall by passage through the wood, and (2) the oscillation of the wood is opposite to that of the air and so absorbs the waves, especially those of low frequency. Many large halls have been examined with shots and musical instruments for production of sound and microphone and valve recording apparatus and it is found that the first effect is negligible, while the absorption in the second, varies inversely as the free space. So it is possible to obtain halls with wooden surroundings, in which the resonance is independent of the frequency of the note. H. M. B.

743. Nature of Vowels. A. Gemelli and G. Pastori. *Rev. d'Acoustique,* 2. *pp.* 169–188, *May,* 1933.—This paper reports and interprets the results of a study of Italian vowel sounds as ordinarily enunciated and is illustrated by plates obtained by means of a microphone, amplifier and oscillograph with photographic registration. It is chiefly concerned with the central portion of a curve which contains the repeated pattern characteristic of a particular vowel sound. Analyses of the pattern are made by the methods of Fourier and Vercelli, the second of which permits the detection of inharmonic components. For detailed results reference should be made to the original paper in which the influence of the phases of the components on the structure of the curves and the presence of inharmonic tones are noted. E. J. I.

744. Apparatus for Receiving Speech through the Sense of Touch. L. D. Goodfellow and A. Krause. *Rev. Sci. Instruments,* 5. *pp.* 44–46, *Jan.,* 1934.—A more detailed account of Gault's teletactor than has yet appeared [see Abstract 4999 (1933)]. The apparatus includes a microphone, an amplifier, and a receiver or vibrator on which the observer places his fingers in order to feel the vibrations of the speaker's voice. The amplifier has an output of 8W. and a diagram of its circuits is given. The receiver may be of the magnetic or condenser type [Rochelle salt crystals] and it carries a knob by which the vibrations are communicated to the finger-tip of an observer. From a graph of the sensitivity of the finger-tip and of the ear [Fletcher] it is seen that as the sensitivity of the ear increases with the frequency, that of the finger-tip diminishes. This gives direction in the design of a new amplifier such that the deaf will feel the vibrations at all pitches in the same relative intensity as the hearing person perceives them through the ear. G. E. A.

745. Mécascope. (Apparatus for the Study of Noise and Vibration in Industry). J. Vassillière-Arlhac. *Rev. d'Acoustique,* 2. *pp.* 225–231, *May,* 1933.—This instrument, used for the localisation of noise and the testing of methods for its mitigation, incorporates an ordinary integral noise meter together with a receiver surrounded by packing material and only influenced by the particular vibrating body with which it is in contact. The set-up of the apparatus is described and examples of its use are given. E. J. I.

746. Character of Bell Tones. A. N. Curtiss and G. M. Giannini. *Acoustical Soc. of America, J.* 5. *pp.* 159–166, *Oct.,* 1933.—Tests were made on a set of church bells in Germantown, Philadelphia. The bell notes cover a range of four chromatic octaves from E*b* below middle C upwards. The testing equipment consisted of a noise meter, two-stage amplifier with loud speaker, a portable motion-picture camera with projector, and a set of tuning forks. The noise meter consisted of a permanent-magnet ribbon microphone to pick up the sound, followed by sufficient amplification to give deflections on a vacuum tube voltmeter. The intensities of the sounds of several bells were measured in the bell tower and on the street, at strike and 10, 20 and 30 seconds after. The acoustic output of the bells was calculated in watts. A complete attenuation curve of the F bell (345·3) was made by recording the meter readings by the camera. The curve has at least five distinct peaks, caused by the building up of different partials to a maximum at different times. Twenty partials are found in the note of the bell with frequencies varying from 130 to 1125. Predominant partials are made up of several tones, the hum note being formed from those with frequencies 160 and 187, and the strike note from 330, 345 and 365. The tones of the bell are further discussed. G. E. A.

747. Nomograph for Acoustic Energy Spectra. D. A. Rothschild. *Rev. Sci. Instruments*, 4. *pp.* 587–589, *Nov.*, 1933.—To construct an acoustic energy spectrum the analysis of an oscillogram produced by a harmonic analyser must be followed by several mathematical processes, *viz.*, the sine and cosine coefficients for each component must be reduced to a single amplitude and the amplitudes thus obtained must be converted to energies, a procedure which involves three steps. The present paper describes a nomograph which facilitates this latter process. J. E. R. C.

748. Optimum Sound Absorption. A. Gemant. *E.N.T.* 10. *pp.* 446–450, *Nov.*, 1933.—An analysis of the requirements for maximum sound absorption. Of the various qualities of the material, porosity, thickness, vibrational characteristics and resistance to flow, the last has the greatest influence. Two limiting frequencies are considered, a higher and a lower, and it is proved that in both cases the most favourable value of acoustic resistance is a few hundred ohms, the actual value depending slightly upon the other qualities of the material. The required resistance may be achieved in practice by suitable choice of the size of fibres and of their surface. E. W.

749. Valve-Maintained Tuning-Fork as Primary Standard of Frequency. D. W. Dye and L. Essen. *Roy. Soc., Proc.* 143. *pp.* 285–306, *Jan.* 1, 1934.—The paper describes the work leading to the installation of a 1000-cycle valve-maintained tuning fork as a frequency standard in continuous operation at a frequency within 1 part in a million of its nominal value. A method of balancing the prongs of the fork was devised. The vibration transmitted to the base of the fork was thereby reduced to a minimum and the frequency of the fork was nearly independent of the manner in which the fork unit was supported. The variations of the frequency of the fork with polarising field strength, air gap, amplitude of vibration, atmospheric pressure, the voltage supplies and the loading of the output coil, were investigated. The logarithmic decrement of the fork was determined for various values of polarising field. A description is given of the final design of the tuning fork, of the air-tight and thermostatically controlled enclosure in which it is installed, and of the electrical circuit employed for driving and taking power from the fork. A chronograph is described which enables the rate between the tuning fork and a standard clock to be read by inspection with an accuracy of 1 part in 10^7, and determined by measurement with an accuracy of 5 parts in 10^8.

Details are given of the performance of the fork over a period of 20 months since its installation. The frequency stability over hourly periods is of the order of 5 parts in 10^8, and over weekly periods, 3 parts in 10^7.

AUTHORS.

750. Production of Sounds from Heated Metals by Contact with Ice and Other Substances. Mary D. Waller. *Phys. Soc., Proc.* 46. *pp.* 116–123 ; *Disc.*, 126–127, *Jan.* 1, 1933.—Experiments in which very loud notes were produced as a result of contact of metal bodies with solid carbon dioxide have been described in a previous communication [see Abstract 1983 (1933)]. The present paper is concerned with the conditions under which soft notes may be produced from heated metal bars brought into contact with ice and a number of other substances. These substances must either sublime or boil or decompose with the evolution of gas, at temperatures for which the metal to be excited still retains adequate vibrating properties. The experiments confirm the theory regarding the mechanism of the phenomenon which was developed in the previous paper. They establish the general conditions under which elastic vibrations of audible frequency may be excited in a metallic body, when contact with another cooler solid substance results in the production of gas from the latter. [See following Abstract.] AUTHOR.

751. Vibrating Properties of Metals at Different Temperatures. Mary D. Waller. *Phys. Soc., Proc.* 46. *pp.* 124–126 ; *Disc.*, 126–127, *Jan.* 1, 1933.—A simple acoustical method of studying the vibrating properties of metals at different temperatures is described. Since the damping of the vibrations, which is mainly due to internal friction or solid viscosity, is greatly altered either by previous heat or mechanical treatment and by impurities, *i.e.* is not constant at any given temperature, such a method capable of giving numerous comparative data over wide ranges of temperature should be of value. Furthermore, there is promise that on account of the large variations of the vibrating properties with temperature it will be possible to obtain, by observations of irregularities in these variations, much interesting information regarding the state of metals and alloys at different temperatures. [See preceding Abstract.] AUTHOR.

See also Abstracts 464, 466, 471.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

752. Accuracy of A.C. Bridge Measurements. R. Tamm. *Zeits. f. techn. Physik,* 14. 11. *pp.* 472–474, 1933.—Treating the uncertainty of a measurement as the reciprocal of the accuracy there are considered (1) the uncertainty of the break, (2) the relative uncertainty of measurement, and (3) the absolute uncertainty of measurement. Under (1) is considered the smallest difference in the bridge which can be detected, this being limited by the immediate response of the receiving instrument. Under (2) is considered the inaccuracy which the bridge possesses when the comparable normals are sufficiently accurate and including errors of bridge measurement. This will depend upon the break field. Under (3) all sources of error are comprised. A high phase accuracy is stated to require special construction for measurement. A variable ohmic resistance with small phase error is described. Finally a small phase measuring bridge is described with which absolute phase measurements can be performed.
R. S. R.

753. Electrical Equivalent Circuits of Coupled Mechanical Oscillation Formations. L. Kettenacker. *Zeits. f. techn. Physik,* 14. 11. *pp.* 515–517, 1933.—The particular kinds and forms of the coupling of mechanical oscillation formations are discussed. From numerous examples it is shown that by use of the electrical equivalent circuits, which are based on the analogy between mechanical and electrical oscillations, the distinctive characteristics of the particular kinds of coupling can be simply and clearly dealt with. J. J. S.

See also Abstract 847.

CONDUCTION AND DISCHARGE IN GASES.

754. Breakdown Voltage of Extremely Pure and Dry H_2 and O_2. H. Fricke. *Zeits. f. Physik,* 86. 7–8. *pp.* 464–478, *Nov.* 15, 1933.—Experiments are described to measure the spark potentials of extremely pure and dry H_2 and O_2 at pressures of 1–60 tor (mm. Hg.) and distances of 1–35 mm. Iron electrodes are used 85 mm. in diameter, ground flat and with rounded polished edges. The gaseous pressures p and the spark distances d are varied and the product is found to deviate from the Paschen law by as much as 10·6 % for extremely pure and dry H_2 in the region $pd = 20$–300 tor mm., and ±5–6 % for extremely pure and dry O_2 in the region $pd = 60$ tor mm. The spark potential of extremely pure and dry H_2 is found to be 10 % lower than that of ordinarily dry H_2, and that of extremely pure and dry O_2 10 % greater than that of ordinarily dry O_2. Tables of the product pd for varying p and d are given. R. L.

755. Probe Measurements in the Electric Arc in Air at Atmospheric Pressure. J. L. Myer. *Zeits. f. Physik,* 87. 1–2. *pp.* 1–18, *Dec.* 13, 1933.—Probe measurements in low current arcs between copper and iron electrodes in air at atmospheric pressure show the existence of a kathode fall of 16·5 volts for iron and 20·6 volts for copper. Both valves are in good agreement with the second ionisation potential of these metals.

The anode fall and the potential drop across the arc itself vary with the arc current and depend on the anode material in a similar manner to that found by Nottingham for the whole arc potential. Arcs between dissimilar metals (Fe, Cu, C, Ni, Zn) show that except when using a Zn anode the kathode fall does not depend appreciably on the anode material. For Fe and Cu kathodes, assuming that about $\frac{1}{8}$ of the arc current at the kathode consists of positive ions, application of Poisson's equation gives for the extent of the kathode fall space thicknesses of the order of 10^{-5} cm., so that a field strength of the order of 10^6V/cm. exists at the kathode surface. A field of this strength is probably quite sufficient to produce appreciable electron currents from Cu and Fe kathodes. A. W.

756. New Kind of Glow Discharge with neither Hittorf Dark Space nor Kathode Fall of Potential. A. Güntherschulze and H. Fricke. *Zeits. f. Physik*, 86. 7–8. *pp.* 451–463, *Nov.* 15, 1933.—An investigation of a new kind of glow discharge obtained when a circular kathode of the resistance material " ozelit " (mixture of SiC+C+clay) is employed in a discharge tube. In none of the gases tried (He, Ne, A, H_2 and O_2) is a Hittorf dark space or a kathode fall of potential observed, but the negative glow occurs right at the kathode itself. A dark space and kathode fall begin to appear if the gas pressure is reduced to very low pressures (about 0·01 mm. Hg.) and also after about eight hours. The kathode loses its activity but can be reactivated by glowing in air or discharging in O_2. The suggested explanation is that electrons are ejected from the " ozelit " kathode with speeds of 20–30 V. and that they have these speeds in an extremely thin high insulation surface layer formed by oxidation, where, owing to the very great resistance, there is a very high field strength. [See following Abstract.] R. L.

757. General Conditions for Glow Discharge with neither Kathode Fall of Potential nor Dark Space. A. Güntherschulze and H. Fricke. *Zeits. f. Physik*, 86. 11–12. *pp.* 821–827, *Dec.* 7, 1933.—A more detailed study is presented of the phenomena described in a previous paper [see preceding Abstract]. Experiments with many materials show that the conditions necessary for obtaining a glow discharge with neither kathode fall of potential nor dark space with a cold kathode are that the kathode shall consist of two parts (1) a material whose specific resistance lies between that of graphite and a semi-conductor, and (2) a thin coating of a very highly insulating material. This layer need not necessarily be continuous. Many substances may be used for the kathode among which the authors cite ozelite, silite, graphite aquadag and copper oxide. A list of 15 materials suitable for the surface coating is given including oxides, carbonates, silicates, glass dust and talc. R. L.

758. Current Transfer in the Mercury Arc (Low Voltage Arc). A. Gehrts. *Phys. Zeits.* 34. *pp.* 870–876, *Dec.* 1, 1933.—A detailed discussion of the distribution of current between electrons and positive ion in the low voltage discharge in rare gases as affected by gas pressure, current density and kathode emission, is followed by a treatment of the mercury arc lamp which is a low voltage arc of specially high current density. For high current densities and when the kathode can supply an excess of electrons, the kathode layer can be regarded as an electrical double layer. At the kathode, the electron current and at the plasma-kathode layer boundary the positive ion current, are limited by space charge, the kathode fall equalling approximately the lowest excitation potential of the gas (4·9 volt for Hg vapour). If the kathode electron emission becomes inadequate the kathode fall increases and from the measured values for the mercury arc (9–11 volt) the contribution of the positive ions to the current is estimated to equal about 2 %. Allowing for positive ions carrying multiple charges, the percentage is increased somewhat (at the most to 5 %). An ion current contribution of 2 % is sufficient to produce an intense field, immediately before the kathode, which lowers the exit work of the electrons (Schottky effect) by an amount which justifies the view that the electron emission from the kathode is principally determined by this field. W. S. S.

759. Diffusion Theory of the Positive Column. R. Seeliger and A. Kruschke. *Phys. Zeits.* 34. *pp.* 883–885, *Dec.* 1, 1933.—From discussion of the work of Krefft, Druyvesteyn and others it is concluded that with respect to the formation of negative ions by electron attachment an explanation must be sought from the fundamental equations for carrier balance and that the phenomena are rather complex, as is to be expected from roughly approximate laws. It appears impossible to give a satisfactory explanation of the effects without taking into account space charge considerations. [See also Abstract 3540 (1933).] A. W.

760. Energy Balance, Electron Temperature and Voltage Gradient in the Positive Column in Mixtures of Na Vapour with Ne, He and A. M. J. Druyvesteyn and N. Warmoltz. *Phil. Mag.* 17. *pp.* 1–27, *Jan.*, 1934.—In a positive column in Na vapour the power input is equal to the sum of the radiation and of the energy given off by the electrons and positive ions to the wall. When a rare gas at a few cm. pressure is admixed to the Na vapour a volume energy is measured, originating from the elastic collisions between the electrons and the rare gas atoms. The behaviour of the electron temperature and the voltage gradient in the positive column in Na vapour with a few mm. of Ne can, for low current density, be explained by means of the formulæ for the positive column. AUTHORS.

761. Ionic Mobilities in the Positive Column. S. Harris. *Phil. Mag.* 17. *pp.* 131–145, *Jan.*, 1934.—Measurements were made on the speed of rotation of the positive column around an annular discharge-tube in air and hydrogen for various values of the strength of the radial magnetic field, of the strength of the electric field, of the pressure of the gas, and of the current through the discharge. Observations were also made on the Hall effect in the positive column under similar conditions of pressure in air and hydrogen. From the two sets of data the ionic velocities in the positive column for various pressures of both air and hydrogen were calculated. The pressure range was from 2 to 5 mm. of mercury. The values obtained from the Hall-effect measurements for the velocities of the negative ions are in fair agreement with the values obtained by Townsend for free electrons. The mobilities of the positive ions in air and hydrogen were calculated to be 0·71 cm./sec. per volt/cm. and 2·23 cm./sec. per volt/cm. respectively at atmospheric pressure by assuming the mobilities of the positive ions to be inversely proportional to the pressure. The fact that these mobilities are lower than the mobilities of the positive ions produced by X-rays in these gases at atmospheric pressure indicates that the positive ions in the positive column at pressures ranging from 2 to 6 mm. of mercury are larger than the positive ions produced in these gases by X-rays at atmospheric pressure. AUTHOR.

762. Negative Sections of the Cold-Kathode Glow Discharge in Helium. K. G. Emeléus, W. L. Brown and H. McN. Cowan. *Phil. Mag.* 17. *pp.* 146–160, *Jan.*, 1934.—An outline is presented of the results of the first part of an investigation of a cold-kathode low-voltage glow discharge in He at about 1 mm. pressure made chiefly by collector methods supplemented optically. Data so obtained are less exact than with discharge forms passing heavier currents, but represent an advance on older methods in enabling outstanding problems to be defined more precisely even when not yet solved. Neglecting the negative glow and Faraday dark-space plasmas, analysis of which is being continued, attention is particularly directed to (1) the collector evidence for emission of fast electrons from the kathode (this illustrates the difficulty of deciding between macroscopic and atomic effects in a discharge); (2) the uncertainty as to the electrical conditions in the gas close to the kathode in the primary dark-space and kathode glow; (3) the fact that analysis of kathode dark-space collector characteristics would possibly yield data for a region of space-charge similar to data obtained with collectors in a plasma; (4) the factors controlling the sharpness of the boundary between negative glow and kathode dark space, *viz.*, the abruptness of the change in slope of the potential curve at the boundary and the mean energy of the slow electrons in the negative glow. AUTHORS.

763. Electron Attachment and Negative Ion Formation in Oxygen and Oxygen Mixtures. N. E. Bradbury. *Phys. Rev.* 44. *pp.* 883–890, *Dec.* 1, 1933.—A direct method is employed to determine the probability of electron capture in oxygen and oxygen mixtures. The principle of the method lies in the analysis of a mixed current stream at two points along its path by means of wire grids which permit only the ionic fraction of the current to pass when a h.f. field is applied between adjacent grid wires. A means of measuring the mobility of the electrons is also possible. The probability of attachment has been determined for oxygen, air, and mixtures of oxygen with the rare gases. The probability of attachment is a marked function of the electronic energy, decreasing with increase in electronic energy. In oxygen and in all mixtures of oxygen however, there is an increase in the probability of attachment occurring at approximately 1·6 volts electronic energy. This can be definitely explained as being due to the appearance of low energy electrons following inelastic impacts with O_2 molecules. The energy at which these inelastic impacts begin is well correlated with the first excited level of the O_2 molecules which is 1·62 volts above the ground state. AUTHOR.

764. Production of Secondary Electrons by Argon Positive Ions and by Argon Atoms. C. J. Brasefield. *Phys. Rev.* 44. *pp.* 1002–1005, *Dec.* 15, 1933.—Argon positive ions with energies up to 150 equivalent volts were found to be very inefficient in producing secondary electrons (from a lamp-blacked nickel collector) as compared with argon atoms of equal kinetic energy. The efficiency of production by these atoms, which were probably in metastable states, was approximately 3·5 %. It is concluded that positive ions, as such, play little or no part in the production of electrons necessary for the maintenance of a cold kathode discharge in gases. AUTHOR.

765. Determination of the Range in Air of Kathode Rays of 35 to 60 kV Energy, by the Wilson Cloud Method. A. Thomescheit. *Ann. d. Physik,* 18. 7. *pp.* 791–804, *Dec.,* 1933.—The range in air of kathode rays of 35–60 kV energy produced in a Lenard tube were determined with a Wilson cloud chamber. The potential corresponding to 1 cm. range in air at N.T.P. is found to be 28,700 volts and the range is proportional to the fourth power of the velocity over the region investigated. The results are in good agreement with a theoretical formula of Bethe. F. C. C.

766. Reduction of the Distortion Due to Space Charge in Braun Tubes. M. v. Ardenne. *Zeits. f. techn. Physik,* 14. 11. *pp.* 461–464, 1933.—After a discussion of the known methods of reducing distortion in gas-filled Braun tubes, two new methods, based on the same principle, are described. In the first method one of the earthed deflecting plates is divided and the two portions are connected to the same battery and a suitable potential placed on each. In the second method two pairs of divided plates are used. The ray paths for various potentials on the plates are discussed. H. J. H. S.

767. Braun Tube as an Electron-Optical Problem. E. Brüche and O. Scherzer. *Zeits. f. techn. Physik,* 14. 11. *pp.* 464–466, 1933.—It is shown that to obtain the maximum sensitivity it is necessary to arrange the deflecting plates in a manner as near as possible to that of an "electron lens" (or magnet coil), and that to obtain the smallest possible image with high sensitivity the ray configuration is such that the Helmholtz law is obeyed. A high vacuum Braun tube, constructed on electron-optical principles, is described. H. J. H. S.

768. Gaseous Combustion in Electric Discharges. Part IX. Kathodic Water-Gas Equilibrium. G. I. Finch, B. W. Bradford and R. J. Greenshields. *Roy. Soc., Proc.* 143. *pp.* 482–486, *Jan.* 1, 1934.—The water-gas equilibrium in the kathode zone of an electric discharge has been investigated. It has been found that the position of equilibrium varies with the final gas pressure. From this and other facts previously established it is concluded that equilibrium is approached from the carbonic oxide side in two ways, pressure being favourable to the one but unfavourable to the other. [For Part VIII see Abstract 1037 (1932).] AUTHORS.

See also Abstracts 581, 604, 629, 639, 643, 644, 645, 646, 647, 681, 682, 818, 825, 829.

CONDUCTION IN SOLIDS AND LIQUIDS.

769. Dispersion Theory in Metallic Conductors. Y. Fujioka. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 459. *pp.* 202–215, *Nov.,* 1933. *In English.*—A further mathematical discussion is given of the dispersion theory in metallic conductors [see Abstract 4512 (1932)]. The effect of a damping factor upon the formulæ for conductivity and dielectric constant is chiefly dealt with. The result of the calculation shows that if the damping factor is considered to be large the effect upon the conductivity is fairly appreciable, while the dielectric constant is scarcely affected. The theoretical formulæ are compared with the experimental result for silver. If suitable numerical values for some constants in the formulæ are chosen the agreement can be considered as satisfactory. J. J. S.

770. Voltage Wave-Forms with the Rotary Voltmeter. P. Kirkpatrick. *Rev. Sci. Instruments,* 5. *pp.* 33–37, *Jan.,* 1934.—The electrical theory of the rotary voltmeter is developed and the conclusion drawn that the instrument may be employed for the analysis of the wave forms of a large class of periodically varying voltages. Two experimental methods for performing these analyses are described and experimental results are presented, pertaining to both high and low potentials. [See Abstract 5292 (1932).] AUTHOR.

771. Measuring Average Current in a Jumpy D.C. Circuit. F. W. Maxstadt. *Rev. Sci. Instruments,* 5. *pp.* 14–17, *Jan.,* 1934.—The paper describes an indicating instrument devised to read directly the average current supplied to a piece of apparatus in a jumpy d.c. circuit while consuming very little voltage. The method is to supply some additional damping to an ordinary d.c. meter without altering the meter itself. Two possible arrangements are discussed from the theoretical standpoint. In the present development a Weston Electrical Instrument Company's model 301 d.c. voltmeter has been rebuilt by substituting a shunt for the voltmeter series resistance. This permits reducing the full scale voltage drop in the meter to 60 mV instead of the standard 100 mV. The meter is completely filled with oil and details are given of the method of sealing off from the air. Such a meter may be used only in a horizontal position unless further special precautions are taken. Many different current waves were used to check the accuracy of the completed instrument and the motions of the needle. Some oscillograms are reproduced. The meter is found to have an accuracy of about 2 % which compares very favourably with the oscillograph. R. L.

772. Measurements at Very High Frequencies. K. Küpfmüller. *Zeits. f. techn. Physik,* 14. 11. *pp.* 447–456, 1933.—A review is given of present-day methods employed for the measurement at very high frequencies of resistance, current and potential, circuit damping, etc. A. W.

773. Cause of the Rise in Electrical Conductivity of Crystalline Bodies as the Melting Point is Approached. M. le Blanc and E. Möbius. *Zeits. f. Elektrochem.* 40. *pp.* 44–46, *Jan.,* 1934.—The electrical conductivity of specimens of solid silver nitrate is determined between 193° C. and the melting point (209° C.), using a Wheatstone bridge arrangement. The values obtained show a behaviour similar to that previously found by the same workers for the specific heat: with progressive purification the rise of conductivity on approaching the melting point becomes steeper and moves to temperatures nearer to the melting point. A quantitative calculation of the effect of impurities on the conductivity is impossible because the distribution of the impurity in the solid salt is not known. The addition of as little as 10^{-6} mol./gm. of Ag_2SO_4 is observed to give a marked effect, and it is considered probable that the whole of the rise of conductivity as the melting point is approached is due, not to incipient melting, but to the presence of traces of impurity. L. A. W.

774. Contact Resistance Measurements at Low Temperatures. R. Holm and W. Meissner. *Zeits. f. Physik,* 86. 11–12. *pp.* 787–791, *Dec.* 7, 1933.—Further resistance measurements are made with Au, Cu and Ni contacts at 20° Abs., and at room-temperature to complete and confirm some previous work [see Abstracts 2683 and 2961 (1932)]. The results show the presence of a surface layer whose transition resistance per

sq. cm. of contact surface is about 10^{-9} Ω for Cu and Au and about 50×10^{-9} Ω for Ni, and is essentially independent of temperature. The transition resistance obeys Ohm's law over a considerable voltage region.
R. L.

775. Mechanism of Rectification in CuS-Mg Rectifiers. M. Anastasiades. *Comptes Rendus*, 197. *pp.* 1397–1399, *Dec.* 4, 1933.—Oscillographic investigation of a commercial Elkon rectifier (Pb/CuS/Mg) points to the fact that the mechanism of rectification is not electrochemical as supposed by its inventor but thermoelectric. It is suggested that rectification is localised in certain points only of the CuS/Mg contact surface where the CuS and Mg have been fused together by arcing. An examination of these contact points shows the presence of Cu_2S and free S. Hence the contact surfaces of the Elkon rectifier at the points where rectification takes place are $Pb/CuS/Cu_2S/Mg$. According to theory the principal contact is Cu_2S/Mg and the rectified current is in the direction $Cu_2S \rightarrow Mg$. [See Abstract 5021 (1933).] R. L.

776. Effect of Points in Crystal Detection. E. Cabanel and J. Cayrel. *Comptes Rendus*, 197. *pp.* 1602–1604, *Dec.* 13, 1933.—Experiments with sensitive galena crystals and points of different curvatures under conditions giving the same contact resistance in all cases show that although the use of a metal point with a galena crystal affords a good means of detection, yet the curvature of the point itself can by no means be considered as the cause of the detection. The curvature of the point is a factor of only secondary importance. A. W.

777. Copper-Oxide Rectifier as a Laboratory Instrument. L. O. Grondahl. *Rev. Sci. Instruments*, 5. *pp.* 24–27, *Jan.*, 1934.—A brief outline is given of the properties of copper-oxide rectifiers and their uses in the laboratory. They are used extensively in charging storage batteries, and as battery substitutes. They enable d.c. apparatus of all kinds to be operated satisfactorily from a.c. circuits, *e.g.* operation of d.c. motors and electromagnetic tractive relays, control of electromagnets, selection of relays or circuits. The rectifiers may also be employed in connection with a.c. measuring instruments of all kinds and may even be used as radio detectors. Various circuits are given illustrating the examples cited and some special applications are included. R. L.

778. Supraconductivity of Zinc. W. H. Keesom. *Physica*, 1. 2. *pp.* 123–127, *Dec.*, 1933.—Zinc becomes supraconductive at 0·79° K. Neither Cd nor Au are yet supraconductive at 0·73°K. nor Pt at 0·77°K. As phosphorbronze is not yet supraconductive at 0·75°K it can be accepted that copper is not yet supraconductive at that temperature.
AUTHOR.

779. Effect of H.F. Currents on the Transition Point of Supraconductors. E. F. Burton, J. O. Wilhelm, A. Pitt and A. C. Young. *Canad. J. of Research*, 9. *pp.* 630–636, *Dec.*, 1933.—The present paper represents a continuation of the work [see Abstract 346 (1933)] on supraconducting phenomena for h.f. currents and the interaction of h.f. and direct currents. It is found for thin films of tin that there is no appreciable change in the transition point for frequencies from zero up to $3 \times 10^7 \sim$. There is no effect on the h.f. point due to d.c. or on the d.c. point due to h.f. currents, when the value of these currents is below about 20 mA. There is a very appreciable effect on the d.c. point when h.f. currents up to 200 mA are superimposed on the d.c. This effect varies with the strength of the h.f. current and not, as thought before, with the ratio of the h.f. to the direct current. AUTHORS.

780. Electrical Conductivity and Other Properties of Binary Aggregates. K. Lichtenecker. *Zeits. f. Elektrochem.* 40. *pp.* 11–14, *Jan.,* 1934.—The paper reviews the contributions which have been made by the author and others in connection with the problem of determining such physical properties as the resistance, dielectric constant, refractive index, hardness, etc., of binary aggregates from a knowledge of the composition and the corresponding properties of the constituents. Particular reference is made to work not mentioned by Frey in his recent paper on this subject [see Abstract 3868 (1932)], and attention is drawn to Frey's misquotation of the correction factor which the present author had suggested to allow for the reduction in volume when applying the logarithmic rule. R. W. P.

781. Electrical Conductivity of α-Silver Sulphide. Part II. C. Wagner. *Zeits. f. phys. Chem.* 23. *Abt.B.* 5–6. *pp.* 469–472, *Dec.,* 1933. —The assumption made in Part I [see Abstract 3170 (1933)] of a predominantly electronic conductivity in α-silver sulphide is supported by further experiment. The significance of the apparent validity of Faraday's laws is discussed in connection with secondary diffusion processes. J. E. R. C.

782. Conduction of Electricity in Solid Silver Sulphide, Selenide, and Telluride. C. Tubandt and H. Reinhold. *Zeits. f. phys. Chem.* 24. *Abt.B.* 1. *pp.* 22–34, *Jan.,* 1934.—The formation of compounds of silver with sulphur, selenium and tellurium from the elements has been investigated with an arrangement in which the silver and the negative element are separated by layers of two or three of these compounds. The results of transport measurements correct the conclusions drawn from previous investigations and show that α-Ag_2S, α-Ag_2Se, and α-Ag_2Te are mixed conductors with predominating electronic conduction. Although, in absolute value, of the same order of magnitude as the conductivities of the best-conducting solid electrolytes, their electrolytic conductivities constitute less than 1 % of the total conductivities. T. H. P.

783. Electrical Conductivity of Nickel Oxide. H. H. v. Baumbach and C. Wagner. *Zeits. f. phys. Chem.* 24. *Abt.B.* 1. *pp.* 59–67, *Jan.,* 1934.—The electrical conductivity of nickel oxide is found to increase with the oxygen pressure in an analogous manner to that of cuprous oxide. In the light of previous considerations an electronic defect is assumed, and this hypothesis has been confirmed by thermal measurements. The oxygen-excess content is so small, that it cannot be determined by direct means, but its infinitesimal order must be calculated from equation constants and diffusion coefficients. H. H. Ho.

784. Conductivity of Synthetic Metallic Bodies. W. Trzebiatowski. *Zeits. f. phys. Chem.* 24. *Abt.B.* 1. *pp.* 87–97, *Jan.,* 1934. —The electrical conductivity of blocks of metals made from gold and copper powder by compression was determined, over a range of temperature from 18° to 600° C. The temperature coefficient was positive up to 100° C., negative to 300° and again positive up to the higher temperature. The reason ascribed for this behaviour was the existence of an adsorbed gas layer and recrystallisation changes. F. J. B.

785. Conductivities of Water in Sulphur Dioxide. M. deK. Thompson and F. C. Jelen. *Am. Electrochem. Soc., Trans.* 63. *pp.* 207–221 ; *Disc.*, 221, 1933.—The conductivities of commercial SO_2 are determined at different temperatures as a function of water content from zero to 1·3 % H_2O. There is no appreciable change in conductivity when the water content is between 0 and 0·003 % H_2O, a rapid change from 0·003 %–0·09 %, and a less rapid change from 0·09 % to saturation. A detailed description is given of the final method adopted of measuring the lower conductivities. For this d.c. is employed reversed every second and with a field strength of 990V/cm. A constant field strength is necessary for comparison since these solutions do not obey Ohm's law. Many distillations are made on the samples before repeatable values are obtained. In all solutions the conductivity increases with time indefinitely. The conductivity temperature coefficients of solutions containing up to 0·06 % H_2O are negative while those with 0·15 % and more are positive. In the *Discussion* **R. R. Ridgeway** pointed out that conductivity measurements are really insulation resistance measurements and that this is entirely a function of the test used to determine it. R. L.

786. Apparatus for Conductivity Measurements. W. K. Sementschenko, B. W. Jerofejew and W. W. Serpinsky. *Zeits. f. phys. Chem.* 167. *Abt.A.* 3. *pp.* 188–196, *Dec.*, 1933.—A method of measuring the conductivity of electrolytes has been devised which obviates the influences of capacity, constituting the principal source of error of the ordinary method, and gives results accurate to 0·02 %. With KCl solutions of 2 to 0·000125 *N*, the results obtained by this method differ markedly from the discordant figures given by most other authors, but agree well with Shedlowsky's data. Within the limits of experimental error and of extrapolation, the results confirm the theoretical Debye-Onsager formula. [See following Abstract.] T. H. P.

787. Conductivity of Mixtures of Electrolytes. W. K. Sementschenko and W. W. Serpinsky. *Zeits. f. phys. Chem.* 167. *Abt.A.* 3. *pp.* 197–208, *Dec.*, 1933.—Conductivities have been determined of sodium nitride from 0·001 to 1·0 *N* ; sodium bromide from 0·000125 to 0·005 *N* ; magnesium sulphate from 0·000166 to 2·0 *N* ; various mixtures of potassium chloride and sodium nitride of total concentration 0·1–0·001 *N* ; similar mixtures of KCl and $MgSO_4$ (0·001–2·0 *N*) ; two mixtures of KCl, NaBr and $MgSO_4$ (0·005–0·0005 *N*). For the single electrolytes, theoretical consideration according to the formula of the Debye-Hückel-Onsager theory reveals better agreement than is shown by older results. The data for the binary and ternary mixtures of low concentration agree well with values of the conductivity calculated on the basis of the additivity of specific conductivity. This agreement is not, however, regarded as confirmation of the independence of the mobility of the ions on the composition of the solution, which is contradicted by the current theory of the conductivity of electrolytes. It is considered that the agreement is produced by an " averaging " of the mobility in the mixture, that is, by increase of the slower and diminution of the more rapid mobilities of the ions. [See preceding Abstract.] T. H. P.

788. Conduction of the Electrolyte in the Measurement of Resistance of Palladium Wire Containing Hydrogen. C. A. Knorr and E. Schwartz. *Zeits. f. Elektrochem.* 40. *pp.* 36–38, *Jan.*, 1934.—

The paper is a reply to D. P. Smith [see Abstract 3167 (1933)] in which certain conclusions of the authors were criticised. F. J. B.

789. A.C. Measurements in Chloroform. H. Eisler. *Zeits. f. Physik*, 86. 11–12. *pp.* 792–796, *Dec.* 7, 1933.—Having investigated the dielectric properties of CCl_4 and CS_2 the author has now investigated the current-voltage characteristics and the dielectric strength of chloroform. The results show that the breakdown strength of chloroform varies inversely as the conductivity. The conductivity is proportionally high for chemically pure chloroform purified in the manner stated. The current-voltage characteristics exhibit at least one and at most two kinks, corresponding to one or two saturation regions. The characteristics in the case of pure chloroform are at first rectilinear then exponential, whereas for impure chloroform they are almost rectilinear. The addition of paraffin has no appreciable influence on either the conductivity or the breakdown strength. R. L.

See also Abstracts 426, 447, 797, 829.

DIELECTRICS AND CAPACITANCE.

790. Conception of Electrostatic Capacity. H. Benndorf. *Akad. Wiss. Wien, Ber.* 142. 2*a*. 3–4. *pp.* 175–183, 1933.—It is suggested that the usual definition of electrostatic capacity which fixes the Maxwell capacity coefficients as measure of the capacity is too narrow and in many practically important cases (such as electrometers) does not fulfil the proper object of the conception of capacity—to be a measure of the ratio of the quantity of electricity given to a conductor to the change of potential produced thereby. It is proposed to define the capacity C of a conductor by the quotient $\partial e/\partial V$ and the mean capacity C between two potentials V and V′ by the mean value $\overline{C} = \{1/(V'-V)\}\int_V^{V'} C dV$. Practical examples are given of the failure of the usual definition and the advantages of the proposed definition of capacity. J. J. S.

791. Interpretation of Electric Polarisation Coefficients. F. R. Goss. *Chem. Soc., J. pp.* 1341–1345, *Oct.*, 1933.—When electric moments are of very small magnitude their interpretation is uncertain because of the possibility of inaccuracy in determining polarisation coefficients. An experimental and theoretical study of the polarisation coefficients is communicated. In the Debye equation, $\mu = 0{\cdot}01273\sqrt{P_0 T} \times 10^{-18}$, the value of P_0 must be known much more accurately for small values of μ. P_0 is equal to $P - (P_E + P_A)$ and for small values of P_0, the other coefficients must be known very accurately. The possible errors in determining each of these factors are discussed and it is shown that theoretically there should be an increase in the total polarisation of a non-polar liquid with temperature, whereas for the vapour the polarisation is independent of temperature and slightly higher than for the liquid. This has been proved experimentally. For benzene the temperature coefficient of total polarisation is identical with that for electron polarisation and therefore P_A is constant for both states and the electric moment is zero. The experimental technique is described in detail. W. R. A.

792. Dielectric Constants of Hydrated Materials. J. Tausz and H. Rumm. *Kolloid-Beihefte*, 39. 1–4. *pp.* 58–104, 1933.—The dielectric behaviour of pulverulent and fibrous materials has been investigated in relation to their water-content and conclusions have been drawn regarding the manner in which the water is held. The influence of temperature, apparent density, structure and frequency is also considered. The dielectric constants of the powders were determined on suspensions in suitable liquid mixtures; with dry materials this isodielectric method is applicable. The high values given in the literature for sugar and starch are not confirmed and are due to the presence of water in the substances examined. The isodielectric method is usually inapplicable with materials containing water, but in many cases the difficulties arising are overcome at low temperatures. With hydrated powders and fibres, the measurements were made with loose layers, the values obtained being not the true dielectric constants but "dielectric values" which are dependent on the apparent density. For some pulverulent substances, the dielectric constants may be calculated from the dielectric values by means of the logarithmic mixture law. In general the dielectric values increase characteristically with the moisture-content, determination of which is possible in this way. From the effect of change of temperature on the dielectric value, it is concluded that the adsorbed water must be present in two forms, which are dielectrically different. The one form, with very low dielectric constant, is termed fixed water, and the other, which increases the dielectric constant considerably, mobile water; the latter, but not the former form, renders the dielectric value more sensitive to changes of temperature. With cut tobacco, at room-temperature water up to 9 per cent is held in the fixed form. With colloidal silicic acid of about the same water-content, however, the dielectric values are still high below 0° C. and the influence of temperature is very great; it may hence be assumed that the water is largely present in the mobile form, with a high dielectric constant. For starches, with much higher moisture-contents, the dielectric values are so low that the water may be regarded as mostly fixed. Besides the temperature, the structure also influences the contents of mobile and fixed water. Moreover, the dielectric values of substances with much mobile water depend greatly on the frequency, such dependence diminishing gradually as the mobile water diminishes in amount. T. H. P.

793. Dielectric Properties of Solutions of Electrolytes in a Non-Polar Solvent. C. A. Kraus and G. S. Hooper. *Nat. Acad. Sci., Proc.* **19.** *pp.* **939–943,** *Nov.,* **1933.**—The dielectric constants of solutions of tetra-isoamylammonium picrate, tri-isoamylammonium picrate, tetra-isoamylammonium bromide, silver perchlorate and meta-dinitrobenzene in benzene have been measured at 25° to concentrations as low as $10^{-4}N$, by Wyman's method modified only by introducing a sensitive precision condenser in the circuit of the variable oscillator in order to interpolate between the harmonics of a fixed frequency crystal oscillator. The increase in dielectric constant due to the electrolytes is enormously greater than that due to meta-dinitrobenzene, *i.e.*, the magnitude of the effect is of a different order from that of ordinary polar molecules. The approximately linear curves of the two picrates, as contrasted with the rather highly eccentric curve for the bromide are of interest in that the latter salt has two symmetrical ions, while of the former, one has an unsymmetrical anion and the other has a somewhat unsymmetrial kation, in addition. Evidently, the symmetry of its ions has a marked influence on the dielectric behaviour of an electrolyte at higher concentrations. The conductance and the freezing point curves of the same electrolytes exhibit similar differences. H. H. Ho.

794. Dielectric Polarisation of Hydrogen Chloride in Solution. Part II. Benzene, Ethyl Bromide and Ethylene Dichloride as Solvents. F. Fairbrother. *Chem. Soc., J. pp.* 1541–1543, *Dec.,* 1933. —In a previous communication [see Abstract 2062 (1932)] it was shown that the dielectric polarisability of HCl in solution in benzene, cyclohexane, and CCl_4 due to the electric moment of the molecules was more than 50 % greater than in the gaseous state, leading to an apparent electric moment of $1 \cdot 3 \times 10^{-18}$ e.s.u. approx. Those experiments have now been extended to include ethyl bromide and ethylene dichloride as solvents, and, with several improvements in technique, a further series of measurements in benzene has also been carried out which are in excellent agreement with those previously obtained. The results for ethyl bromide and ethylene dichloride, however, lead to values of the electric moment which are almost the same as those of Zahn for gaseous HCl, *viz.,* $1 \cdot 03 \times 10^{-18}$ e.s.u. The Debye equation on which the calculations are based only holds strictly for measurements in the vapour state or in very dilute solution or in a non-polar solvent. When the solvent molecules are as polar as those of the solute, or more polar, as in the solutions in ethyl bromide and ethylene dichloride, the equation can only be roughly true; a closer agreement with the value for the moment in the gaseous state could not therefore be expected. H. H. Ho.

795. Dipole Moments of Long-Chain Molecules. J. W. Smith. *Chem. Soc., J. pp.* 1567–1570, *Dec.,* 1933.—From measurements of the dielectric constants and densities of dilute solutions of palmitic acid, myristic acid, and methyl myristate in benzene, and assuming that the atomic polarisation of these molecules is approximately 15 % of the electronic polarisation, their electrical dipole moments ($\times 10^{18}$) have been evaluated as 0·72, 0·76, and 1·61, respectively. These results are discussed with reference to the variation of the electric moment of a molecule with the length of the carbon chain, and also with reference to the association of fatty-acid molecules in benzene solution. AUTHOR.

796. Dipole Moments of Chlorobenzophenone Oximes. G. S. Parsons and C. W. Porter. *Am. Chem. Soc., J.* 55. *pp.* 4745–4746, *Dec.,* 1933.—The dipole moments of the six oximes obtainable from monochlorobenzophenone have been measured with sufficient accuracy to determine the relative values in the three pairs of *cis-trans* isomers. Within the limits of accuracy obtainable with our equipment the two *ortho* compounds have identical moments. The higher melting forms of the *meta* and *para* compounds have the lower dipole moment. The chlorinated phenyl group shifts to the N atom when the low-melting form is subjected to the Beckmann rearrangement. The unsubstituted phenyl group migrates when the high-melting oxime undergoes the Beckmann change. AUTHORS.

797. Electron Velocity in Insulators at High Field-Strengths and its Relation to the Theory of Electric Penetration. A. Güntherschulze. *Zeits. f. Physik,* 86. 11–12. *pp.* 778–786, *Dec.* 7, 1933.— If to a highly insulating material sufficient field strengths are applied then the electrons introduced from the kathode are so far driven into it that they issue from it with velocities of 20 to 30 e. volts. This great electron acceleration which is the cause of the electric penetration (or breakdown) of insulators and takes place in an extraordinarily short time exists in the following three cases as lasting state: (1) with the glow

discharge without kathode fall which occurs if as kathode an extremely thin layer of an insulator upon an underlying half conductor is employed; (2) with the electrolytic valve metals, where it produces in the stoppage direction the fluorescence illumination in the oxide layer and in the flow direction the kind of ionic separation which completely deviates from the usual electrolysis; (3) with the ozelit and silit resistances (formed from a mixture of silicon carbide and graphite) where it causes the strong and rapid decrease of the resistance of those materials with rising potential.
J. J. S.

See also Abstracts 426, 769, 780, 789.

ELECTROCHEMISTRY.

798. Dry Cells with Solid Radioactive Electrolyte and Ionised Air. L. Bouchet. *Comptes Rendus,* 197. *pp.* 1598–1599, *Dec.* 18, 1933. —Two suitably hollowed discs, the lower of zinc, the upper of brass, are insulated from each other by a ring of mica. The hollow in the zinc disc is filled with powdered uranyl nitrate cemented in with paraffin. The e.m.f. on first making is 0·61–0·70 V, usually 0·65–0·66; after six months it falls to about 0·54 V, at which it remains approximately constant (within 2 %) for several years. If the cell is short circuited through a resistance of 120 ohms, and after a time insulated again, the polarisation slowly disappears and after a time the e.m.f. is higher than before the short circuit.
C. A. S.

799. Electrolysis of Methyl Alcohol Solution of Cupric Chloride. E. Guillermet. *Comptes Rendus,* 197. *pp.* 1608–1610, *Dec.* 18, 1933.— When a methyl alcohol solution of cupric chloride (5 %) is electrolysed with a Pt kathode and a Pt or Cu anode and a current density of 1·3–5 A/dcm^2., Cu and CuCl in proportions varying from 0 to 80 % Cu are deposited at the kathode, while at the anode the Cl liberated forms CuCl if this is of Cu, and remains free or reacts with the alcohol if it is of Pt. The primary reaction is $CuCl_2 = CuCl + Cl$; the Cl partially reacts with the alcohol forming HCl which on electrolysis gives free H which explains the Cu at the kathode. The poor yield (sometimes only 8 %) is due to direct recombination of CuCl and dissolved Cl.
C. A. S.

800. Electrolysis of Sodium Sulphide. W. Bohnholtzer and F. Heinrich. *Zeits. f. Elektrochem.* 39. *pp.* 939–947, *Dec.,* 1933.—The process has been studied mainly by determination of voltage-current density curves, with the object of producing sulphur and sodium hydroxide solution from alkali solutions used for the removal of hydrogen sulphide from gases. With a bright electrode and very small potential (0·1 volt) the current density is very low and polysulphides alone are formed. With increase of the potential the anode becomes covered wtih a thin film and the current falls still lower; this state is transitional and with slow rise of potential changes to one in which yellow sulphur deposits on the anode, with rise of current and fall of voltage. The sulphur formed redissolves to form polysulphide. In the final stage the anode voltage is high (2 volts); at low current density the electrode is free from sulphur, and sulphate and dithionate, but no polysulphide, are formed, whilst at high current density sulphur is again deposited, and polysulphide, sulphate, dithionate, and thiosulphate are formed. Somewhat similar changes occur with polysulphide solutions. Appreciable current, however, flows in the first stage, when the electrode is bright, until the supersaturation with sulphur at the anode becomes too high, when the current is arrested by the formation of a film on the electrode. The stage of deposition and redissolution of sulphur does not occur in polysulphide solutions, the sulphur separating in large masses at the anode. At very high current density sulphur together with oxygen is thrown off from the anode, and thiosulphate and other compounds are formed. H. F. G.

801. Electrolytic Deposition of Rhodium. G. Grube and E. Kesting. *Zeits. f. Elektrochem.* 39. *pp.* 948–958, *Dec.*, 1933.—Bright rhodium deposits may be obtained from sulphate, fluosilicate, fluoborate, perchlorate, and oxalate solutions, all of which may be regenerated by addition of freshly prepared hydroxide. The deposition has been studied quantitatively for several of these solutions and for phosphate and chloride solutions. Polarisation is high, and even at relatively low current density simultaneous evolution of hydrogen occurs. The current yield at 0·002–0·007 ampere per cm. is of the order 80–90 %. H. F. G.

802. Spectroscopic Investigation of the Degree of Dissociation of Mercury Halides in Solution. H. Fromherz and Kun-Hou Lih. *Zeits. f. phys. Chem.* 167. *Abt.A.* 1–2. *pp.* 103–128, *Dec.*, 1933.—The degree of dissociation and association of salts and complexes of the halogen salts of mercury was investigated by means of systematic determinations of the absorption of light. The measurements were carried out in aqueous solutions. The results indicated that the water solutions of mercury halogen salts were practically undissociated at all the concentrations investigated. In alcoholic solutions the maxima of the light absorption curves were, compared with those of water solution, displaced towards the red, and were lowered by dilution. F. J. B.

803. Activity Coefficients and Transference Numbers of Potassium Iodide. R. W. Gelbach. *Am. Chem. Soc., J.* 55. *pp.* 4857–4860, *Dec.*, 1933.—E.m.f. measurements of concentration cells of KI were made, employing potassium amalgams and silver as electrodes. The determinations were carried out at a temperature of 25° C. The Debye-Hückel constants were determined for KI, and the activity coefficients were calculated. Accurate values for the transference numbers were obtained from the measurements. F. J. B.

804. Kohlrausch's Theory of Moving Boundaries. I. Mukherjee. *Kolloid Zeits.* 65. *pp.* 297–301, *Dec.*, 1933.—It is shown that the assumptions on which are based the derivation of the Kohlrausch equation for adjusted concentrations of two uni-univalent electrolytes, and which depend on the layers of these electrolytes which are immediately adjacent to the boundary, are invalid, and that a transition layer must be assumed in which adjustment of velocity of the common ion must be made. It is further shown that the criticisms of McInnes and Dole, and of Hacker and Bikerman, that the apparent deficit in the number of common ions behind the boundary can be explained by a change of concentration of the ions, when the boundary passes a given point, depends on a misunderstanding of the conditions in the layers of two electrolytes in the immediate neighbourhood of the boundary. H. H. Ho.

805. Overvoltage of Metals. N. Thon. *Comptes Rendus,* 197. *pp.* 1312–1314, *Nov.* 27, 1933.—Deductions from the view that the relation between current and overvoltage is linear do not agree with experiment.

The hypothesis of energies of activation [see Abstract 646 (1929)] does not give satisfactory results for metals deposited in good crystals, *e.g.*, Pb, Zn, Cd, Bi, Cu and Ag, that of active centres [see Abstract 1059 (1931)] affording a better explanation; while the reverse is the case as regards Fe, Co, Ni, and complex salts of other metals. The absence of any active centre in a gaseous kathode explains the high overvoltage in such [see Abstract 339 (1934)]. C. A. S.

806. Ta and Cb versus Pt Kathodes. D. F. Calhane and C. M. Alber. *Am. Electrochem. Soc., Trans.* 63. *pp.* 173–179, 1933.—The paper presents comparative results obtained with Pt, Ta and Cb kathodes in the electro-analysis of solutions containing Cu, Ag, Zn and Ni. The Pt kathode is in gauze form and the Ta and Cb kathodes are perforated sheets, since Ta and Cb gauze is not yet available. The results with Ta and Cb electrodes compare favourably with those of Pt. In the determination of Zn, Ta and Cb have the advantage over Pt in that an undercoating of Ag or Cu is unnecessary, while the Cb kathode gives slightly better results than either Ta or Pt. For accurate results with Ta kathodes the surface must be mechanically cleaned after every few depositions. Further experiments are in progress on the relative tendency of Ta and Cb metals to oxidise in various electrolytes. R. L.

807. Direct Determination of Number of Active Centres on a Crystalline Metallic Kathode. N. Thon. *Comptes Rendus*, 197. *pp.* 1606–1608, *Dec.* 18, 1933.—The explanation of overvoltage as due to increase in resistance along the paths of electrons towards "active centres" leads to the expression $1/2\pi rn\chi(=\eta/i)$ for the resistance, where n is the number of centres, r the radius of one, χ the specific conductivity of the electrolyte, η the overvoltage, and i the current density. It is shown that n is approximately equal to the number of crystals actually observed in the deposited metal in the cases of zinc and copper, and r of the order 10^{-8} cm. when the deposit is near equilibrium with i and η both near zero. If this theory holds for larger values of i and η, as seems probable, r must increase with i [see Abstracts 418 (1930) and 5430 (1933)]. C. A. S.

808. Normal Potential of the Quinhydrone Electrode. H. S. Harned and D. D. Wright. *Am. Chem. Soc., J.* 55. *pp.* 4849–4857, *Dec.*, 1933.—The e.m.f.s of the cell Pt/quinhydrone, HCl(0·01*M*)/AgCl/Ag, and of the normal quinhydrone electrode were studied. A method of employing the latter in cells without liquid junctions was developed. The reproducibility in 0·01*M* HCl was carefully investigated and it was found that the e.m.f. was reproducible to within 0·1mV at temperatures between 0° and 40° C. F. J. B.

809. Glass-Electrode Potentiometric Determination of the pH Values of Weakly Buffered Solutions. J. O. Burton, H. Matheson and S. F. Acree. *Bureau of Standards, J. of Research*, 12. *pp.* 67–73, *Jan.*, 1934.—In the electrometric measurement of the pH values of buffered solutions more dilute than *M*/10,000 by means of quinhydrone and hydrogen electrodes the resistance of the solution, escape of carbon dioxide, acid properties of the quinhydrone, and polarisation of the electrodes are so disturbing that the e.m.f. readings may vary as much as 5 to 30 mV or 0·1 to 0·5 pH unit. The isohydric-indicator technique is apparently applicable within 0·1 pH to such solutions, and distilled water, but has not heretofore been compared with a reliable e.m.f. method. By adding

Varley shunts to a modification of the valve potentiometer used by Partridge, keeping the grid attached to the circuit, and using a Thompson glass electrode, e.m.f. readings can be made within 0·1 to 2·0 mV on weakly-buffered solutions and distilled water, and the pH values agree with those obtained by the isohydric-indicator method. This apparatus is also suitable for measuring the pH of solutions containing active oxidising or reducing agents, such as chlorine or tannins, where the hydrogen and quinhydrone electrodes and indicator methods might fail. AUTHORS.

810. Corrosion and Coordination. H. L. Riley. *Roy. Soc., Proc.* 143. *pp.* 399–410, *Jan.* 1, 1934.—The rates of solution of copper and nickel in aqueous solutions of the sodium salts of oxalic, malonic, succince, phthalic, carbonic, acetic, benzoic, citric, tartaric and salicylic acids have been measured and compared. The greater corrodibility of copper is determined by its tendency to form sparingly dissociated complex ions. The dominant factor determining the rate of corrosion is the nature of the anion present in the solution; "couple action" has little or no effect. The influences of concentration, acidity and area on the rate of corrosion are briefly examined. J. S. G. T.

See also Abstracts 414, 492, 680, 793.

ELECTRONS, POSITRONS AND PROTONS.

811. Materialisation and Annihilation of Electrons. F. Perrin. *Comptes Rendus*, 197. *pp.* 1302–1304, *Nov.* 27, 1933.—The author considers the possibility of the materialisation of a pair of electrons at a collision of electrons. Assuming one electron at rest, this is not possible unless the incident electron has kinetic energy exceeding $6mc^2$. The motion of the four resulting electrons is considered from the point of view of observation. The author also considers the annihilation of a pair of electrons, (*a*) in presence of one other, which is projected, whilst a single photon is emitted; and (*b*) in presence of two others, which are projected in opposite directions without emission of a photon. T. L. M.

812. Positive Electron. P. M. S. Blackett. *Nature*, 132. *pp.* 917–919, *Dec.* 16, 1933.—Positive electrons were discovered as components of cosmic radiation by the cloud method. Terrestrial sources of positive electrons are now available since they are produced (1) in certain nuclear transformations, (2) when hard γ-rays are absorbed by matter. In the last method, the number of positive electrons produced increases rapidly with the energy of the γ-ray quanta and the atomic number of the absorber. It is probable that pairs of positive and negative electrons are born just *outside* the nucleus by annihilation of a γ-ray quantum; the reverse process in which a positive and negative electron interact with each other and the field of an atom to produce a single quantum of radiation also occurs and the positive electron consequently exists for only a short time in matter at ordinary densities. The positive electron must have a spin of $\frac{1}{2}$ and so obey the Fermi-Dirac statistics; that Dirac's theory of the electron predicts the existence of particles with just these properties gives strong support to the theory. Since protons are rarely observed among the cosmic ray components at sea-level it is probable that the positive particles are positive electrons. Now the majority of the particles incident on the earth's atmosphere are positively charged; the main flux of radiation in inter-galactic space must therefore be in the form of positive electrons. The total mass of this radiation has been estimated as 1/1000 of the mass of all the stars and nebulæ and so it appears that the positive electron though rare, because ephemeral, on earth, is an important constituent of the universe as a whole. F. C. C.

813. Displacement, in a Magnetic Field, of Magneto-Electronic Spirals. L. Cartan. *Comptes Rendus*, 197. *pp.* 1604–1606, *Dec.* 18, **1933.**—Thibaud has recently described a method of collecting "positrons" in which use is made of the properties of the trajectories of charged corpuscles in a heterogeneous magnetic field with radial symmetry [see Abstract **4449** (1933)]. Mathematical treatment of the case where an electrostatic homogeneous field, directed in any manner whatever, is superposed on a constant magnetic field, shows that the elementary magneto-electronic spirals undergo a displacement directed along a line inclined at a certain angle with the direction of the magnetic field. The results obtained are briefly discussed in their relation to Thibaud's work and also to Villard's theory of the aurora borealis. A. W.

814. Electron Orbits in Crossed Electric and Magnetic Fields. A. E. Shaw. *Phys. Rev.* 44. *pp.* 1006–1011, *Dec.* 15, **1933.**—The focussing properties of crossed electric and magnetic fields for electrons have been investigated for the case of circular orbits, and it has been found that this combination of fields provides extremely sharp focussing, which is in very good agreement with the theoretical predictions. Measurements of the electric field intensity have revealed the presence of polarisation layers which form on the plates of the electric field. These layers reduce the effective potential which is used to deflect the electron beam. The absolute magnitude of these layers has been measured for gold and bronze, and it has been found to depend upon : (*a*) material of the plates, (*b*) gas pressure, and (*c*) electron intensity. These layers are found to be constant under a fixed set of condition and to vary in a reversible manner as conditions are altered. In addition, permanent insulating layers may be formed if electrons bombard a metal surface. Errors in e/m determinations may be traced to these layers and tests are developed for their elimination. AUTHOR.

815. Masses of the Proton and Electron. A. S. Eddington. *Roy. Soc., Proc.* 143. *pp.* 327–350, *Jan.* 1, **1934.**—The conclusion reached in this paper is that the mass m of an elementary particle (proton or electron) is given by the quadratic equation $10m^2 - 136mm_0 + m_0^2 = 0$, where $m_0 = (h/2\pi c)\sqrt{N/\rho}$, N being the number of such particles in the universe, and ρ being the radius of curvature of an empty region, equal to $\sqrt{(3/\lambda)}$ where λ is the cosmical constant. Except for a slight difference in the definition of N and ρ, this result agrees with the formlæ suggested in preliminary papers [see Abstracts 701 and 1515 (1932)]. A review of the physical principles underlying the calculation is given. The mathematical analysis is a continuation of that developed in earlier papers [see Abstract **343** (1932)], and a general familiarity with the wave tensor calculus is assumed. AUTHOR.

816. Quantitative Study of the Collisions of Electrons with Atoms. R. B. Brode. *Rev. Modern Physics*, 5. *pp.* 257–279, *Oct.*, 1933. —Contains an account of the more direct experiments that give quantitative information about the probabilities of collision, excitation, ionisation and scattering of electrons. The probability of collision is found to depend on the velocity of the electron and on the potential field of the atom. The probability of collision for high velocity electrons decreases uniformly with increasing velocity. The magnitude of the probability of collision with different atoms is proportional to the atomic number of the element for high velocity electrons. For slow electrons similar curves are obtained for the variation of the probability of collision with electron velocity in the case where atoms or molecules have similar external electronic structure. The theoretical solution of the problem in the case of slow electrons is obtained by considering the diffraction of the electron wave by the potential field of the atom. The theoretical calculations are in good agreement with the experimental results. The probability of ionisation may be considered as a probability of excitation to a state where one of the electrons of the atom acquires sufficient energy to escape from the potential field of the atom. The shapes of the curves for the probability of ionisation and excitation are discussed. H. L. B.

817. Polarisation of Diffused Electron. W. M. Elsasser. *Comptes Rendus*, 197. *pp*. 1186–1188, *Nov*. 20, 1933.—Förster has shown [see Abstract 5446 (1933)] that no polarisation effect is obtained if a stream of electrons is reflected by a potential which varies only with respect to a single coordinate. A single generalisation of this result is given here by showing that for any potential whatsoever Born's method never gives a polarisation effect as a first approximation. This effect has been found for the special case of Coulombian potential by Mott, who has shown that polarisation effects occur only in the terms of second order. The present result excludes the possibility of polarisation being observed in the case of an extended class of phenomena connected with diffusing electrons. H. L. B.

818. Complex Processes for the Creation of Pairs of Electrons. L. Goldstein. *Comptes Rendus*, 197. *pp*. 1596–1598, *Dec*. 18, 1933.—It is demonstrated that the probability of the creation of pairs of electrons with simultaneous ionisation of an atom, when the latter either absorbs a photon or collides with an electron of sufficiently high energy, is finite. But this probability is smaller than the probability obtained when a heavy nucleus is substituted for the atom in this process. G. C. McV.

819. Theory of Scattering of High Speed Electrons. J. Winter. *Comptes Rendus*, 197. *pp*. 828–829, *Oct*. 16, 1933. *J. de Physique et le Radium*, 4. *pp*. 732–740, *Dec*., 1933.—Indicates certain approximations in the author's method for calculating the angular distribution of electrons scattered by a spherically symmetric disturbing atomic system [see Abstract 4254 (1933)], which are valid for incident electrons of sufficiently high speeds. In these circumstances the formula of the Born method is obtained. W. S. S.

820. Reflection of Electrons from Liquid Mercury. R. B. Brode and E. B. Jordan. *Phys. Rev*. 44. *pp*. 872–875, *Dec*. 1, 1933.—The number of electrons reflected elastically from a mercury surface has been observed as a function of the electron velocity and of the angles of incidence and reflection of the electrons. When the initial beam struck the surface normally the reflected current was symmetrical on both sides. Measurements were made with velocities from 20 to 70 volts and with angles of incidence from 10° to 90°. The total number of elastically reflected electrons decreased rapidly with increasing velocity. The intensity of the reflected electrons was not proportional to the cosine of the angle of reflection, but showed a preference toward reflection backward to the direction of the initial beam. Measurements made with the incident beam at other angles than normal to the surface showed the same preference toward reflection in the direction backward to the direction ot the inital beam. AUTHORS.

821. Electron Scattering in Methane, Acetylene and Ethylene. A. L. Hughes and J. H. McMillen. *Phys. Rev.* 44. *pp.* 876–882, *Dec.* 1, 1933.—The scattering coefficients for elastic collisions between electrons and molecules of methane, acetylene and ethylene have been measured over the following ranges: for CH_4, 10 to 625 volts, 10 to 150 deg., and for 800 volts, 10 to 50 deg.; for C_2H_2, 10 to 100 volts, 10 to 150 deg.; for C_2H_4, 10 to 225 volts, 10 to 150 deg. Total absorption coefficients due to elastic scattering were computed by integration. For 100 volts and above, the scattering coefficients of electrons by the molecules with two C atoms were far smaller than the coefficient for CH_4 with one C atom, but for 10 volt electrons the scattering was much less in CH_4 than in the other two gases. Evidence for interference effects between the electron waves scattered by individual atoms was indicated by the presence of maxima in the curves for the ratios of the scattering coefficients for C_2H_4 and CH_4 (also for the pair C_2H_2 and CH_4) expressed as functions of scattering angles. The ratios were also computed by the well-known formula for the intensity of the resultant waves emitted by a molecule, *viz.*, $\Psi'^2 = \sum_1^n i \sum_1^n j \psi_i \psi_j \sin x_{ij}/x_{ij}$, where ψ_i and ψ_j are the electron wave amplitudes due to the atoms i and j, and x_{ij} is a parameter involving the distance apart of these atoms. Fairly satisfactory agreement between experiment and calculations was obtained for the ratio for C_2H_4 and CH_4, on the assumption that the scattering is done by the H atoms alone. Presumably the slow electrons do not penetrate enough to come under the influence of the C atom. To get satisfactory agreement in the case of C_2H_2, however, it was necessary to assume that the C atoms exerted their full effect. AUTHORS.

822. Electron Diffraction and the Imperfection of Crystal Surfaces. L. H. Germer. *Phys. Rev.* 44. *pp.* 1012–1015, *Dec.* 15, 1933.—Bragg reflections are obtained by scattering fast electrons (0·05 Å) from the etched surfaces of metallic single crystals. The surfaces studied are a (100) face of an iron crystal, (111) face of a nickel crystal and (110) face of a tungsten crystal. In each case the reflections occur accurately at the calculated Bragg positions with no displacement due to refraction. A given reflection is found, however, even when the glancing angle of the primary beam differs considerably from the calculated Bragg value—by over 1° in some cases—so that several Bragg orders occur simultaneously. The accuracy with which this glancing angle must be adjusted is a measure of the degree of imperfection of the crystal. From the electron experiments estimates are made of the widths at half maximum of electron rocking curves. These widths are 0·8° for the iron crystal, 1·5° for the nickel crystal and somewhat over 1° for the tungsten crystal. X-ray curves for these same crystals are much narrower, although the observed widths vary considerably with the treatment of the surfaces. It is concluded that the values obtained from the electron measurements apply to projecting surface metal only, and that the degree of misalignment is much greater at the surface than deep down within the crystal. Furthermore, even the X-rays [Mo $K\alpha$ radiation — 0·71 Å] are not sufficiently penetrating to yield values certainly characteristic of these metal crystals. AUTHORS.

823. Structure of Carbon by Electron Diffraction Method. F. Trendelenburg, E. Franz and O. Wieland. *Zeits. f. techn. Physik*, 14. 11. *pp.* 489–495, 1933.—Owing to the marked reciprocal action between electrons and single atoms, conclusions regarding the constitution of surface layers may be drawn from experiments on electron diffraction, whereas X-ray experiments, owing to the penetration of the rays, yield information only about the deeper layers. In experiments on carbons with widely varying crystallite sizes (natural and artificial graphites, and soots) the electron interferences observed are, in all cases, space-lattice interferences, corresponding with the ortho-hexagonal unit cell of graphite ($a = 4\cdot25$, $b = 2\cdot46$, $c = 6\cdot79$). When the crystallites are very small, certain slight changes occur in the identity periods, c, for instance, increasing somewhat. The intensity relations of the space-lattice interferences with the electron numbers of medium velocity employed are quite different from those of X-rays. The results obtained show that the carbon surfaces parallel to the basal plane are different from surfaces parallel to the c-axis; the former are electron-optically smooth, so that space-lattice interferences do not appear, whilst all other surfaces are electron-optically rough. T. H. P.

824. Structure of Copper Oxide Films by Electron Diffraction. C. A. Murison. *Phil. Mag.*, 17. *pp.* 96–98, *Jan.*, 1934.—The oxide films formed on copper by heating and the powdered oxides of copper were studied by electron diffraction. The powdered oxides give the cuprous or cupric oxide structures, but the surface films give only curpous oxide or an unknown structure. The treatment necessary for the formation of the unknown structure has been found. Chemical analysis shows it to be a new form of cupric oxide. AUTHOR.

825. Crystallographic Investigations with the Electron Microscope. E. Brüche and H. Johannson. *Zeits. f. techn. Physik*, 14. 11. *pp.* 487–488, 1933.—Describes a series of microphotographs of a barium azide kathode with a nickel base metal, obtained with the electron microscope. In the final stage of activation the barium atoms were apparently present as a thin film on the nickel crystals, which was not removed by heating to 1350° C. The electron micrographs, taken with a kathode temperature of 1000° C., showed the crystalline surface structure of the nickel, as established by etching the surface at the conclusion of the experiment. The photographs also indicate crystallographic variations in the surface and represent the highest resolution yet obtained with the electron microscope. W. S. S.

826. Scattering of Electrons by Stibnite and Galena. A. G. Emslie. *Phys. Rev.* 45. *pp.* 43–46, *Jan.* 1, 1934.—A study has been made of the scattering of 20–60 kV electrons, produced in a hot kathode tube, by cleavage surfaces of stibnite and galena. The patterns from stibnite consist of spots, Kikuchi lines, bands, circles and parabolæ. The spots are a surface grating effect with high resolving power for both surface directions. It is concluded that the cyrstal has relatively large mosaic units and that collisions with atoms, involving small energy losses, cause high absorption of the primary beam as it penetrates the crystal. Inelastic collisions, producing excitation of the thermal vibrations of the crystal are considered. They cause increased scattering at angles just larger than the Bragg reflection angles and thus give a reason for the bands. The circles are considered to arise from the localising of an electron's wave packet to the neighbourhood of a single row of atoms, a process initiated by an inelastic encounter with a single atom. The measurements indicate a p.d. of about 26 volts between the row of atoms and the outside of the crystal. The parabolæ, which occur also with galena, are thought to be due to the confinement of an electron to a single plane of atoms. AUTHOR.

827. Elastic Scattering of High Velocity Electrons by Mercury Atoms and the Agreement with Mott's Theory. E. B. Jordan. *Phys. Rev.* 45. *pp.* 47–48, *Jan.* 1, 1934.—The angular distribution of electrons scattered elastically by single mercury atoms has been studied for electrons of 900, 1160, 1600 and 2000 volts energy. The angle range was 8° to 48°. The values of the scattered intensities have been plotted and compared with the corresponding theoretical curves computed in accordance with Mott's theory. The theoretical and experimental curves for 900 volt-electrons differ markedly in shape. The slope of the experimental curve is much greater for small angles than that of the theoretical curve. The departure from Mott's curve decreases progressively for electron velocities corresponding to 1160, 1600 and 2000 volts energy. The 2000 volt curve shows good agreement with the corresponding theoretical curve. AUTHOR.

See also Abstracts 405, 407, 413, 655.

ELECTROSTATICS.

828. Electrostatic Factors in Polar Reactions. W. A. Waters. *Chem. Soc., J. pp.* 1551–1557, *Dec.,* 1933.—Equations have been derived (*a*) for the field effect of ionic charges and of permanent dipoles, and (*b*) for the induced and inductively transmitted effects of ionic charges and permanent dipoles. These support the empirical equation of Nathan and Watson for reactivity, *viz.,* $E = E_0 \pm C(\mu + a\mu^2)$. The term $C\mu$ is suggested as that to be correlated with the direct, or field, effect, and the term $Ca\mu^2$ with the induced polarisation effect. Bond polarisabilities are computed from bond refractivity data, and indicate that the transmission of chemical reactivity by induction in any organic molecule should be much smaller than by direct action across space. This is in accord both with qualitative experience and with the small value (0·032) for the factor a of Nathan and Watson. Secondary effects, due to the disturbances set up in the arrangements of intermediate atoms in a polarised chain, are shown to be of second-order magnitude only. This will also apply to effects between molecules in any reaction mixture, and hence local electrostatic fields due to molecules will not appreciably change the frequency of intermolecular collisions from that calculable for electrically neutral molecules. AUTHOR.

829. Calibration of H.T. Electrometers with the Aid of Kathode Rays. K. H. Stehberger. *Ann. d. Physik,* 18. 5. *pp.* 586–592, *Nov.,* 1933.—An apparatus is described which enables the velocity v of kathode rays to be determined, which have fallen through a given p.d., V. The kathode rays are made to pass between two condenser plates where they are subjected to crossed electric and magnetic fields. The intensities of the latter are so adjusted that the kathode rays are undeflected and impinge on a fluorescent screen. The measurement of the kathode-ray velocity by this method reduces to the determination of certain apparatus dimensions, and a resistance. Knowing v, the voltage V is derived from the formula $V = (m_0v^2/2e)(1 - v^2/c^2)^{-\frac{1}{2}}$, where m_0/e is the ratio of mass to charge of an electron and c is the velocity of light. W. S. S.

830. Portable H.T. Generator. E. H. Bramhall. *Rev. Sci. Instruments*, 5. *pp.* 18–23, *Jan.*, 1934.—The paper discusses the design and construction of a van de Graaff electrostatic generator capable of an output of 500 μA and more than a million volts. A new design is proposed embodying improvements which are based on the operation of this machine over a long period. AUTHOR.

See also Abstracts 790, 798.

CALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

831. Effect of Pressure on Galvanomagnetic Phenomena. C. Bellia. *N. Cimento*, 10. *pp.* 221–229, *June*, 1933.—Laminæ of bismuth, antimony and tellurium were subjected to pressures, applied over the whole surface, ranging from 1 to 50 atmospheres, and measurements were made of the effect of pressure on the coefficient of the Hall effect and on the change in electrical resistance due to a magnetic field. For bismuth, the Hall effect coefficient increased from 2·583 to 2·750 as the pressure rose from 1 to 50 atmospheres, most of the change occurring in the range 1 to 5 atmospheres. For antimony a slight decrease in the coefficient was observed. The change of electrical resistance due to a magnetic field was found for all three substances (Bi, Sb, Te) to be independent of pressure. From the experimental data, a calculation of the number of free electrons per cubic cm. indicated that for Bi this number increased with pressure, a result which might explain the increase in electrical conductivity due to pressure. W. S. S.

832. Change of Resistance of Single Crystals of Gallium in a Magnetic Field. Part I. W. J. de Haas and J. W. Blom. *K. Onnes Lab., Leiden, Comm. No.* 229*b*. *Physica*, 1. 2. *pp.* 134–144, *Dec.*, 1933.—The change of resistance of single crystals of pure gallium in the magnetic field has been determined at hydrogen temperatures. In accordance with the results on single crystals of bismuth, the results become more and more complicated at higher field strengths and lower temperatures. The results are in agreement with the rhombic crystal structure of gallium as determined by Laves. AUTHORS.

833. Thermomagnetic Study of Nickel Salts in the Solid State. (Miss) A. Serres. *Ann. de Physique*, 20. *pp.* 441–477, *Dec.*, 1933.—While Curie's law $\chi \cdot T = C$, with C about 1·30, holds generally for nickel salts in solution, salts in the solid state are more nearly represented by Weiss' law $\chi(T - \theta) = C$, and in agreement with Cabrera and Dupérier, it is found, for the anhydrous salts of nickel chloride and sulphate that the following equation is correct: $(\chi - a)(T - \theta) = C$, where a is a paramagnetic constant. Nickel cyanide is much more feebly paramagnetic and seems to obey Weiss' law without any correcting constant. H. M. B.

MAGNETISM AND ELECTROMAGNETISM.

834. Calculation of the Susceptibility of Nickel near the Curie Point. L. Néel. *Comptes Rendus*, 197. *pp.* 1195–1197, *Nov.* 20, 1933.—The problem of the calculation of susceptibility curves is resolved on the hypothesis of a fluctuation of molecular fields in the Weiss theory. Explanations are suggested for deviations from the calculated values in the case of nickel. W. R. A.

835. Possible Explanation of the Dependence on the Field of the Susceptibility at Low Temperatures. L. Landau. *Phys. Zeits. d. Sowjetunion*, 4. 4. *pp.* 675–679, 1933.—The chlorides of Cr, divalent Fe, Co and Ni possess the peculiarity that at ordinary temperatures their magnetic susceptibility strongly increases with falling temperature, but at low temperatures they show no ferro-magnetism but only a dependence of the susceptibility on the field. The author suggests an explanation of this anomaly deduced theoretically and in agreement with the known facts. Since the named elements can form both ferro- and paramagnetic compounds it may be concluded that the reciprocal force of orientation of the spin can be positive as well as negative dependent probably chiefly on the distance between the atoms. The substances named form crystal lattices in which the paramagnetic atoms lie in layers in which the distance between the layers is actually greater than the distance between the atoms in the layer. If it is assumed that the forces of orientation within a layer are positive but those of different layers upon each other negative and besides actually smaller, the following picture is got. At low temperatures there are spontaneously magnetised layers whose magnetic moments are however orientated in reversed directions so that no spontaneous magnetisation of macroscopic extent exists and so no ferromagnetism. Since the reciprocal action of different layers is comparatively small a comparatively weak field suffices to change strongly the opposite orientation of the moments. Thus deviations from the linear law of the dependence of the total moment on the field are produced and finally saturation phenomena in which the magnetic field orientates the magnetic moments of all layers parallel to its direction. The quantitative theory of the phenomenon is discussed. J. J. S.

836. Strongly Reversible Phenomenon in the Magnetisation of Ferromagnetic Bodies in Extremely Low Alternating Fields. H. Wittke. *Ann. d. Physik*, 18. 6. *pp.* 679–700, *Nov.*, 1933.—The present work constitutes an extension and refinement of the method due to Jordan on the measurement of the losses sustained in ferromagnetic bodies ascertained by means of a bridge circuit. The small variation of a magnetic field of finite dimensions has a definite influence, of the first order of magnitude, on the ratio of the resulting loss to the magnetic energy, which is directly proportional to the field alteration (*h*). The magnetisation of ferromagnetic materials exhibits reversible phenomena under these conditions. The (*h*) factor, in the expression deduced for the relative losses, decreases with increasing previous magnetisation. In contrast, if the small cycle proceeds in non-magnetic conditions, *i.e.* (H_0=O) then the variation of the state of affairs is irreversible. The transformation due to a weak a.c. is therefore never free from loss, the extent of the loss depending upon the material itself, the order of magnitude being about 0·1 % of the magnetic energy change. Thus when one states that for ferromagnetic materials, a reversible phenomenon exists up to the singular case where H_0=O, it must be remembered that for technical purposes this exceptional case has a particular significance. S. G. B.

837. Magnetisation Curve for Ferromagnetic Materials in Very Weak Fields. R. Gans. *Ann. d. Physik*, 18. 6. *pp.* 701–704, *Nov.*, 1933.—In order to clear up misunderstandings and discrepancies between

V.
19

the classical results of Rayleigh and modern measurements, a new set of experimental results are quoted in the present note. The results of Jordan and Wittke are considered and it is shown that a series of definite interpretations of the Rayleigh equations can account for the differences apparently existing between theory and practice. S. G. B.

838. Temperature Dependence of Ferromagnetic Saturation. P. S. Epstein. *Nat. Acad. Sci., Proc.* 19. *pp.* 1044–1052, *Dec.*, 1933.—Allen and Constant have published data on the saturation intensity of magnetisation at low temperatures for monocrystalline materials, which fit in to a definite law. Let the saturation intensity at a temperature T be denoted by M_{ST}, by M_{S0} at the absolute zero, and let T_c represent the Curie point. If the ratio M_{ST}/M_{S0} is plotted against T/T_c the points for all ferromagnetic crystals of the cubic system fall on to the same universal curve. Two other curves obtain for hexagonal and ortho-rhombic crystals. The present author's previously published theory of ferromagnetism leads to the same results for simple cubic crystals and he now extends its application to cover the data of Allen and Constant. It is shown that a constant left indeterminate in the previous theory can be chosen to effect good agreement with the experimental data. The characteristic temperature θ which appears in his formulæ and tables does not coincide with the Curie point T_c, but is proportional to it, roughly 2/3. Putting $\theta=0\cdot81\ T_c$ and plotting the ratios as before, satisfactory agreement is obtained. The theoretical aspects and inferences are fully discussed. S. G. B.

839. Permanent Magnetism of Fired Earths. E. Thellier. *Comptes Rendus*, 197. *pp.* 1390–1401, *Dec.* 4, 1933.—Fired earths (bricks and pottery) become magnetised when cooled in a constant magnetic field. It is generally admitted that this magnetisation although feeble is very permanent and at every point is in the direction of the field in which the cooling takes place. Experiments are made with cubes and parallelepipeds made from a homogeneous mixture of equal parts of Noron clay and slightly ferruginous sand. The results verify the above supposition and show also that the magnetisation depends largely on the conditions of firing (duration, temperature, atmosphere of the furnace), and appears to be unaltered by the earth's field in which the bricks are subsequently placed and by the ordinary atmospheric variations of temperature. R. L.

840. Magnetic Anisotropy in Crystals of Trans-di-nitro-tetrammino-Cobaltichloride. L. W. Strock. *Zeits. f. phys. Chem.* 23. *Abt.B.* 3. 4. *pp.* 235–238, *Nov.*, 1933.—The rhombic crystals of the above substance orientate themselves during crystallisation in a magnetic field with $\beta=[100]$ parallel to the lines of force. These crystals are magnetically anisotropic, and their constants and the elementary cell were determined. G. E. A.

841. Magnetic Susceptibilities of Ions. K. Kido. *Tohôku Univ., Sci. Reports*, 22. *pp.* 835–869, *Oct.*, 1933. *Report No.* 311 *of the Research Inst. for Iron, Steel, and other Metals. In English.*—Theoretical methods of evaluating screening constants and diamagnetic susceptibilities of ions are reviewed and a brief outline of experimental methods of evaluating the susceptibilities of ions is given. From an experimental determination of the susceptibilities of nitrates, halides, sulphates, carbonates, and acetates of the alkali, alkaline earth, copper and zinc groups, together with some cyanides, sulphides, thiocyanates, and oxides of these and other metals, the author has calculated a number of ionic susceptibilities. When the theoretical susceptibilities of Angus [see Abstract 4599 (1932)] are plotted against valency charge on the ion, hyperbolæ are obtained for each isoelectronic ionic sequence; whereas the curves obtained from the susceptibilities deduced experimentally by the author for the same ionic sequences are very different. Curves are given in which the valency charge is plotted against the difference, χp, between the theoretical and experimental values for each ionic sequence. The experimental ionic susceptibility is equal to $\chi p + \chi d$, where χd is the calculated diamagnetic susceptibility and χp is a paramagnetic effect of uncertain physical significance (probably due to distortion of an electron orbit). The susceptibilities of CeO_2, TiO_2, SnO_2, and ZnO have been measured at temperatures between 20° and 800° C. and the values do not vary with temperatures. Values are given for ions of the β sub-groups, for ions with incomplete shells, and for the compound ions of acid radicals. From a consideration of the susceptibilities of the CO_3'', NO_3', SiO_3'', PO_3', and NO_2' ions it is deduced that in these compound ions one of the oxygen atoms is united to the central atom by a double bond and the paramagnetic effect of the double bond is evaluated as 6×10^{-6}. Calculated and observed susceptibilities for a number of organic compounds, alkyl radicals, acids and esters, aldehydes and ketones, benzene derivatives, nitro compounds, and alcohols are compared. [See Abstracts 5259 (1932) and 2059 (1933).] W. R. A.

842. Absolute Magnetic Susceptibility of Water and its Change with Temperature. H. Auer. *Ann. d. Physik*, 18. 6. *pp.* 593–612, *Nov.*, 1933.—The susceptibility of pure water, found by an improved U-tube method, is $\chi = 0{\cdot}72183 \times 10^{-6} \pm 0{\cdot}67$ ‰, and it is confirmed that the temperature coefficient $\frac{1}{\chi_t} \cdot \frac{d\chi}{dt}$ falls from $2{\cdot}9 \times 10^{-4}$ at 5° to $0{\cdot}62 \times 10^{-4}$ at 70° C. G. E. A.

843. Absolute Magnetic Field Measurement. H. Auer. *Ann. d. Physik*, 18. 6. *pp.* 613–625, *Nov.*, 1933.—A standard field produced in a circular coil of one turn was balanced magnetometrically against an auxiliary field set up in an iron-free solenoid giving about 200 gauss/ampere, the currents required in the two coils, to give the same field, being measured. The field to be measured was about 8000 gauss, and its magnitude was compared with that of the auxiliary field by means of a ballistic double coil whose windings could be arranged to give sum or difference effects. The accuracy attained in the final measurement was $\pm 0{\cdot}26$ per thousand. [See preceding Abstract.] G. E. A.

844. Magnetic Susceptibilities of Europium and Gadolinium Compounds. P. W. Selwood. *Am. Chem. Soc., J.* 55. *pp.* 4869–4875, *Dec.*, 1933.—The magnetic susceptibilities of Eu_2O_3, $Eu_2(SO_4)_3$, 8 H_2O, $EuSO_4$, Gd_2O_3, $GdCl_3$, and $Gd_2(SO_4)_3 8H_2O$ have been measured from −190 to 70 or 100°. The effective Bohr magneton numbers for europium are in good agreement with quantum mechanical predictions. The susceptibility and electronic configurations of Eu^{++} are the same as those of Gd^{+++}. The Heisenberg exchange interaction forces for the gadolinium compounds are shown to be proportional to the magnetic concentration as in the case of neodymium. H. H. Ho.

845. Effect of Tension on the Magnetic Hysteresis of Permalloy. T. Aizawa and G. Wachi. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 351. [20 *pp.*], 1933. *English Abstract.*—The results are given of

V. 19

experiments carried out on the effect of tension upon the magnetic hysteresis properties of Ni-Fe alloys containing from 40·05 % to 79·6 % Ni. With the exception of the alloy containing 40·05 % Ni all the others show the minimum hysteresis loss at a certain value of the applied tension. The magnetic induction of the permalloys under tension is lower than that under no tension when they are placed in a weak magnetic field, and this condition continues up to a certain field intensity at which the magnetic induction increases abruptly to its saturation value, producing a hysteresis loop of rectangular shape. This change disappears on stopping the tension, and the decreased initial permeability is recovered somewhat; but, the magnetic property, as a whole is degraded on account of the mechanical deformation produced by the application of tension. The results are in good agreement with the results of Buckley and McKeehan [see Abstract 2763 (1925)] and also that of Preisach [see Abstract 1216 (1933)]. AUTHORS.

846. Magneto-Elastic Measurements. W. Janovsky. *Zeits. f. techn. Physik*, 14. 11. *pp*. 466–472, 1933.—The effect of pressure, tension, torsion and flexure on the hysteresis loops of ferromagnetic materials of positive and negative magnetostriction is discussed. The choice and treatment of the most suitable material for the examination of magneto-elasticity is considered. Two types of apparatus are described, one for small and the other for large deforming forces. The advantage of the apparatus over previous types is discussed and illustrated by describing the results of tests on a given sample of material. H. J. H. S.

See also Abstracts 446, 469, 487, 541, 699, 714.

MEDICAL RADIOLOGY AND ELECTROLOGY.

847. Direct-Coupled Amplifier for Action Currents. E. L. Garceau and A. Forbes. *Rev. Sci. Instruments*, 5. *pp*. 10–13, *Jan*., 1934. —A detailed history is given of the development of valve amplifiers for use in connection with string galvanometers or oscillographs, for electrophysiology, the chief use being in the detection and measurement of "action currents" in excitable nerves and glands. Most methods have employed a large condenser in the output circuit to eliminate the effect of d.c. on the galvanometer. This makes them unsuitable for the measurement of the comparatively long impulses found in glands and some muscles. A steady direct coupled amplifier for such measurements is therefore desirable. The amplifier described is a development of the Wynn-Williams valve bridge, in which the valves form two arms of the bridge, the other two being pure resistances. The bridge is balanced by means of a differential filament rheostat and a variable resistance in one plate circuit. Two such bridges are arranged in series, and the coupling can be either direct or capacity. A single battery, earthed at one end, provides the grid bias and anode voltage for all the valves; it is claimed that this gives great stability to the system. The oscillograph used is a sensitive Hindle string galvanometer. Examples are given showing the sensitivity and stability of the instrument in practice. J. E. R.

848. Production of Local Heat in Body Tissue by H.F. Electric Fields. F. W. Bishop. *Radiology*, 21. *pp*. 487–491, *Nov*., 1933.—Heat for therapeutic purposes may be applied to the body by means of electric lamp irradiation, but the deeper tissues are little affected, as is the case with direct application of hot compresses. Heat can be applied to deep structures by means of h.f. diathermy apparatus, but, in many cases, it is difficult satisfactorily to apply the electrodes of such machines. A more recent method is to cause the desired rise of temperature by placing the affected part of the body in a h.f. field. An apparatus for the application of such h.f. energy is described schematically and illustrated. The apparatus depends upon the use of valves, giving a frequency of 10,000 kc. and the details given are considered to be sufficient to permit construction of the apparatus. Use of such h.f. energy is considered preferable to the use of the ordinary diathermy apparatus. B. J. L.

849. Data on the Spectral Erythemic Reaction of the Untanned Human Skin to Ultra-Violet Radiation. W. W. Coblentz and R. Stair. *Bureau of Standards, J. of Research,* 12. *pp.* 13–14, *Jan.,* 1934.—This paper gives a revision and an extension in spectral range of the data, previously published on the spectral erythemic reaction of the untanned skin. [See Abstract 3459 (1932).] AUTHORS.

850. Measurement of the Thermal Radiation of the Skin. J. Saidman. *Comptes Rendus,* 197. *pp.* 1204–1206, *Nov.* 20, 1933.—Describes a thermopile, in reasonably portable form, which may be used for determining the thermal radiation from the skin. The pile consists of 12 to 15 elements of constantan-nichrome strips 0·02 to 0·05 mm. thick, mounted in a draught shield of cellophane. Calibration sufficiently good for practical purposes may be carried out by means of an approximately black body consisting of a blackened vessel containing water at suitable temperatures. The instrument may be used for medical purposes, notably for finding the extent of infection by observing the local rise in temperature. The sensitivity of the instrument is such that adequate deflections may be obtained at distances of 5 to 8 cm. from the skin. G. E. B.

OSCILLATIONS.

851. Electrical Characteristic Vibrations of Conductors in the Form of Rods, Circular Rings and Spirals. K. F. Lindman. *Ann. d. Physik,* 18. 7. *pp.* 805–815, *Dec.,* 1933.—Further measurements made are in agreement with the author's previous results for the characteristic wave-length of the fundamental vibration of cylindrical conductors and give values which are somewhat smaller than those calculated by Hallén's formula [see Abstract 3431 (1932)]. For the wave-length of the fundamental vibration of a thin metallic circular ring entirely surrounded by air and with a vanishingly small opening a value was obtained which exactly agreed with the value calculated by Hallén's formula. Investigations with a spiral of variable height with a small number of turns of wire gave in the expression for the characteristic wave-length $\lambda_1 = 2lf$, where l is the length of the wire, values for f which are smaller (on account of the small number of windings) than those calculated by Lenz's (and Hallén's) theory. J. J. S.

852. Differential Frequency Indicator. J. Groszkowski. *Journ. Sci. Instruments,* 11. *pp.* 6–10, *Jan.,* 1934.—The design, construction and performance of a new type of differential frequency indicator are described. The arrangement is intended for the monitoring of the frequency of a radio transmitter. The resonant frequency of a sharply tuned circuit, which is coupled to the source of radio-frequency oscillation, is caused to change periodically, from the one to the other of two fixed but adjacent values, by the switching of a small auxiliary condenser. The a.c. induced in the circuit by the source is rectified and the direction of the rectified circuit is periodically reversed in synchronism with the switching of the auxiliary condenser. These rectified currents operate a galvanometer, the deflection of which is consequently proportional in magnitude and sense to the difference between the oscillator frequency and the mean of the two resonant frequencies of the tuned circuit. A relay in series with the galvanometer can be made to operate a bell or other indicator when the frequency deviation exceeds an assigned amount. A means of minimising the temperature coefficient of frequency of the tuned circuit is also described. AUTHOR.

853. Power Amplifier for Laboratory Use. R. S. Dadson. *Journ. Sci. Instruments*, 11. *pp.* 18–23, *Jan.*, 1934.—A description is given of a power amplifier suitable for acoustical and other laboratory work. The instrument is operated from the a.c. mains and has the advantage of giving uniform amplification over the most important part of the audio-frequency range. AUTHOR.

See also Abstract 421.

PHOTOELECTRICITY.

854. Effect of Temperature on the Energy Distribution of Photoelectrons. Part I. Normal Energies. L. A. DuBridge and R. C. Hergenrother. *Phys. Rev.* 44. *pp.* 861–865, *Dec.* 1, 1933.—An experimental test has been made of DuBridge's theory of the distribution of normal energies of photoelectrons [see Abstract 3249 (1933)]. With a modified parallel-plate method of analysis, photoelectrons were ejected from a strip of Mo foil which could be held at any desired temperature. Current-voltage curves for temperatures from 300° to 965° K show a good agreement with the theory. From the shifts required to fit the experimental and theoretical curves the values of V_{max} at 0° K can be determined. For any fixed temperature these values of V_m fit the Einstein equation, and for a fixed wave-length they are independent of T, as required by the theory. [See following Abstract.] AUTHORS.

855. Effect of Temperature on the Energy Distribution of Photoelectrons. Part II. Total Energies. W. W. Roehr. *Phys. Rev.* 44. *pp.* 866–871, *Dec.* 1, 1933.—An experimental rest of DuBridge's theory of the total energy distribution of photoelectrons. Photoelectrons were released from an outgassed Mo filament placed at the centre of a large collecting sphere connected to an FP-54 amplifier and current-voltage curves obtained for filament temperatures from 300 to 1000° K. The effect of temperature on the tail of these curves is quite pronounced, and when analysed by DuBridge's method the curves show an excellent agreement with the theory. The derived energy distribution curves are also in general agreement with the theory and show, at room-temperature, a most probable energy much closer to the maximum energy than obtained by other investigators. Further analysis of the theoretical curves has shown that fortunately they are of such a form that the temperature effect has probably not introduced appreciable errors in the determinations of *h* by the photoelectric method. [See preceding Abstract.] AUTHOR.

856. Spatial Distribution of Photoelectrons Ejected from the Atomic K-Shell. J. A. van den Akker. *Phys. Rev.* 45. *pp.* 49–55, *Jan.* 1, 1934.—With an electron velocity analyser and modified Geiger-Müller electron counter, the longitudinal space-distribution of electrons ejected from the *K* energy level of copper by Mo $K\alpha_1$ has been determined. Asymmetries in the experimental and theoretical distributions are compared and lack of satisfactory accord with wave mechanics is found. The effects of nuclear scattering are briefly discussed. A convienent asymmetry factor, *k*, is introduced. It is possible to compute *k* from data given by other investigators and, from an analysis of the statistical errors in the Wilson method, to compute probable errors. This is done and it is shown that a probably real difference, amounting to 10 %, exists between the experimental and wave-mechanical asymmetries. Computations from an early but erroneous wave-mechanical treatment are in excellent accord with experimental results. AUTHOR.

857. Action of Light on Thin Metallic Laminæ. Q. Majorana. *N. Cimento*, 10. *pp.* 261–285, *July*, 1933.—Continuing previous work [see Abstract 3250 (1933)], it is found that the electrical resistance of a thin lamina of Pt, Ag, Au and Sn is increased when the lamina is strongly illuminated. The effect is very small with Al and Zn and is non-existent with Na. Besides varying with the nature of the metal, the magnitude of the effect depends on the thickness of the lamina and the frequency of interruption of the light. If the lamina is immersed in running water the effect is unaltered, but in still water it is sensibly reduced. There is always a phase lag in the effect of about 45° when pulsating light is used; under some circumstances this may be reduced to about 35°. The experiments seem to show the existence of a new type of direct action of light on electrical resistance. Unlike the photoelectric effect it is not manifested immediately the light is incident nor can it be explained away on purely thermal grounds. F. C. C.

858. Photoelectric Yields in the Extreme Ultra-Violet. C. Kenty. *Phys. Rev.* 44. *pp.* 891–897, *Dec.* 1, 1933.—The photoelectric yields for various surfaces (Ni, W, Mg, W–O and Constantan) illuminated by the extremely short wave-length radiation given out by the positive columns in He, Ne and A respectively, have been determined. The effect of the extremely short wave-length radiation was separated from that of the complete radiation by the use of a quartz disc which, when inserted, cut off all radiations, below 1500 Å. The yields obtained (in electrons per 100 quanta) range from 11 in the case of constantan and He, to 0·14 in the case of Mg (surprisingly) and Ne. The yields, *e.g.* for well degassed Ni for He, Ne and A were 4·4, 1·6 and 0·6 respectively; those for the other surfaces except Mg varied with the gas in the same general way. Thus the maximum in the yield for most ordinary metal surfaces probably lies on the short λ side of 584 Å. W–O gave greater yields than W (except in A) and in general undegassed metals gave yields several times greater than well degassed ones. The size of the yields suggests that the photoelectric emission from probe and kathode surfaces in the rare gases may be of considerable importance. AUTHOR.

See also Abstracts 488, 689.

THERMIONICS.

See Abstracts 764, 825.